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WRESTLING WITH THE GYROSCOPE IN CHINA

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Legal Triumph of the Wrights

THE decision which has been handed down by the Circuit Court of Appeals in the infringement suit brought by the Wright Company settles once and for all, in this country at least, the question: Who invented the flying machine? To be sure, there was never any doubt in the popular mind. Practical achievement counts for so much and paper discussion for so little, that the inventor who rises above the mere theoretical presentation of his ideas is inevitably glorified. The decision of the Circuit Court of Appeals stamps the popular verdict with approval and recognizes Orville and Wilbur Wright as the inventors of the man-carrying, motor-driven aeroplane.

The decision is historically and psychologically interesting because it proves once more how small is the gap between success and failure in invention. Not a single one of the elements in the original Wright machine was new. Chanute had first used the trussed frame with success. Maxim had first placed the horizontal rudder forward. The method of controlling the lateral balance by changing the impact angles of the wings had been proposed over and over again. The vertical rudder was an obvious mechanical expedient for directing the machine in a horizontal plane. Ader and others had proposed or used sled runners. Not a single element in the machine was absolutely novel; yet as a whole it was the most novel mechanism that could be imagined. Not until the Wright brothers appeared had anyone flown successfully in a motor-driven flying machine. Why? Simply because they were the first to recognize the necessity of using the vertical rudder in connection with the wing-warping mechanism in order to prevent the skidding of the aeroplane in straight-away flight—a skidding produced by the increase of resistance on one side and a decrease on the other side in warping the wings. Slight as that discovery seems, it made success possible where only failure had been encountered before.

This is the history of many other inventions. Morse, Bell, Fulton and the rest, all of them seized the abandoned devices of their predecessors and combined them into commercial operative inventions. To the world at large it seems but a little thing to step in this manner from failure to success; yet only a master mind succeeds in grasping the true relation of a dozen mechanical devices, hitherto uncombined, and in uniting them in some brilliant invention for which the world is immeasurably richer.

The decision in the Wright case ought to lay low the idea that the invention of a light gasoline motor made the flying machine possible. If that were really true, the man-carrying aeroplane should have appeared twenty years ago. To be sure, the motors of that period were not light; but on the other hand, the long flights that have been made in recent years with two, three and even five passengers, proved conclusively that lightness of motor was not the only consideration. The Wright brothers succeeded, not because they built a light motor with their own hands, but because they had solved a problem in aero-dynamics which had baffled the best scientific thought of centuries.

Tire Failures and Railway Speed

AS the result of its investigation of a derailment which occurred last year at Stockwell, Indiana, the Interstate Commerce Commission came to the conclusion that the accident was caused by a broken tire on one of the car wheels.

A most illuminating and interesting branch of the Commission's investigation of accidents is that which is carried on by the Bureau of Standards, to which sections of broken rails, broken tires or other informing fragments from railroad wrecks are sent, for thorough microscopical, chemical and physical analysis, and the deduction of the proper lesson therefrom. This was done in the case of the broken tire above mentioned, with the result that the Bureau found the breakage resulted from heat cracks which had formed in the tread of the tire.

Now the high temperatures to which car tires are subjected are due to brake action, the heating effects of which are considerably aggravated by the high speed under which modern express traffic is carried on. The heating of the tires depends upon the pressure applied by the brake, the speed of rotation of the wheels, and the time during which the brake is applied. Evidently the greatest heating effect will be produced if the brakes are applied continuously at maximum pressure when the train is running at top speed.

How greatly the heating of the tires is aggravated by high rates of speed is evident if we consider the case of two trains, one of which is running at 80 miles an hour and the other at 60 miles an hour. In this case, since the momentum of the train varies as the square of its speed, the energy transformed into heat at the brake shoes will be twice as great at 80 miles an hour as it will be at 60 miles an hour. If the brakes are applied at full pressure at 80 miles an hour, the train will run over 1,500 feet before the speed has been reduced to 50 miles an hour, that is to say, the train would run for 1,500 feet at an average speed of nearly 65 miles an hour with the brakeshoes on under full pressure.

Hence, during a small fraction of a minute, the greater part of the energy of the moving train is converted into heat on the abutting surfaces of the brakeshoes and the tires. The outer inch or so of the tire is very rapidly raised to a high temperature, and it reaches that temperature quicker than the heat can be conducted to the inner portion of the tire. Now we must remember that the tire was originally fastened to the body of the wheel purely by shrinkage effects, and that when the hot tire cooled, it was thrown into a condition of heavy tensile stress throughout its whole thickness. Hence the theory has been advanced that when the sudden heating of the outer layers of the tire under the frictional contact of the brake takes place, the outer metal of the tire expands and the inner metal has to carry, for the time being, the whole of the heavy initial stresses of shrinkage. A condition may be reached in which the shrinkage tensional stresses are too great for the unheated section of the tire, and in this case fractures, known as thermal cracks, may occur. These fractures may be difficult to detect; and hence there is a call, particularly on high-speed trains, for most careful and systematic inspection.

A Comparison of British and American Battleships

WE publish on our correspondence page a letter in which the writer draws a comparison between the British 25-knot battleships of the "Queen Elizabeth" class and our own latest battleships. He claims that, because the armor of the British ship is thicker (though there is some doubt as to this) the principal gun heavier, and the speed greater, therefore the "Queen Elizabeth" must be a more effective ship than our "Nevada" or "Pennsylvania."

Now the displacement of the "Queen Elizabeth" and the "Nevada" is given as about the same. But this means that when the English ship is loaded with the same proportion of her total amount of ammunition, fuel, stores, etc., as the "Nevada," she will be of considerably greater displacement; for the English displacement, as given in published statements, represents the weight of the ship, not when she is in fighting condition, as it does in the case of the ships of our Navy, but when she has only a limited portion of her fuel and stores aboard.

Now as to the superiority. The English 15-inch gun is of one inch larger caliber than the 14-inch gun carried by the "Nevada." But our correspondent does not know, probably, that the muzzle velocity of the English gun is considerably lower than that of our 14-inch gun; that the energy is not very much greater; and that the penetration at the probable battle range of ten thousand yards is about the same, although the bursting charge of the 15-inch gun, of course, is considerably larger. Furthermore, he omits to state that the "Nevada" carries ten 14-inch guns as against eight 15-inch guns carried by the "Queen Elizabeth." Also, there is reason to believe that the fuel supply of the "Nevada" is greater than that of the "Queen Elizabeth," that is to say, that she could keep the sea longer without calling up the colliers or returning to a coaling station. And, yet again, any one who is familiar, even in a general way, with naval design, knows that the extra weight put into machinery to secure 25 knots as against 21 knots is so great that some other important military element in the ship, such, for instance, as the internal subdivision as a defense against torpedo attack, which in our ships is most elaborately worked out, and is probably more complete than it is in the British ships, must have been sacrificed in favor of boilers and engines.

It is an accepted principle of the tactics of a line-of-battle engagement, that the fleet must be kept together as one unit, the speed of the faster ships being accommodated to that of the slower, so that the latter be not left behind to be cut off and sunk in detail by the enemy. The average speed of the British fleet, like that of our own, is about 21 knots; or, say, 18 to 20 knots in an actual engagement. If the British 25-knot "Elizabeths" are to lie in line with the rest of the fleet, they must not use their highest speed, but must carry within their hulls hundreds of tons of motive power, which they may never be called upon to use throughout the whole engagement.

The British naval staff, in designing these five remarkable ships, has, no doubt, assigned to them some definite work in the strategy and tactics of the various war plans which it is the duty of the staff to formulate and work out. In the absence of knowledge of what these plans are, the ships look to be an odd size—too fast for the first line of battle; too slow for the 28-knot battle-cruiser class.

A New Use for Patents

WHEN the distinguished Dr. Ehrlich, the discoverer of salvarsan, better known as "606," was asked by a German medical association why he had patented his remedy, he replied that he wished to control its manufacture, not in order to make money, but in order to protect the public by guaranteeing its quality. Thus he showed that a professional man may use a patent for a purpose which probably never entered the heads of those who framed the patent laws of civilized countries.

The medical profession, as Mr. Burton Hendricks points out in his article, "The New Medical Ethics," published in a recent number of *McClure's Magazine*, is rapidly abandoning the foolish principle of not patenting its discoveries, for the very reason given by Prof. Ehrlich. It is better to run the risk of being accused of commercialism than of permitting dishonest manufacturers to make a remedy as they see fit. The physician himself cannot guarantee these various products. Hence the need of some method which will insure the public against fraud, and hence the value of patents.

This opens up the question why the patent laws should not be extended to cover discoveries in applied science which cannot now be legally protected. Burbank gives the world a new fruit, a fruit more nutritious, more reproductive, more palatable than any that mankind has known before. It costs him a fortune to experiment before he finally develops it to marketable perfection. No patent laws protect him from the appropriation of his discovery. So, too, the application of Mendelian principles to plant and animal breeding where they involve what may be regarded as the equivalent of invention, should certainly be accorded some protection. Why was not the discovery of Hellrigel that the bacteria nodules on the roots of leguminous plants reduced the nitrogen of the atmosphere in the form of an absorbable nitrogenous fertilizer patentable? Its later improvement has enriched the world by millions. And so we could enumerate a hundred practical scientific discoveries which have enriched the world, but which are now left to the tender mercies of quacks and frauds.

Recovery of Lost Handwriting by Photography

FADED handwriting is perplexing to antiquarians and lawyers and its recovery may be of importance. A recent method depends on the fact that most inks, even ancient inks, are acid in reaction. Nitrated silver chloride paper is kept in contact with the faded text twelve hours or more and then exposed to full light. The action of the acid in the ink on the silver chloride brings about a reaction which is completed by sunlight—reduction to metallic silver which now shows in metallic luster on a dark ground. It is impossible to make this image permanent, but it is legible for a short time. This writing may be made more readily visible by submitting the paper, after exposure, to the fumes of burning phosphorus in a closed box. Another method of developing this image after contact with the faded manuscript is to pour mercury on it from a height of about a foot and then immerse the paper in dilute ammonia. Or the exposed paper may be placed in bright sunlight for fifteen minutes and then pressed against a dry plate which is afterward developed with dilute rodinal. Dampening the faded document permits the aid of a weak solution of hydrogen peroxide.

Engineering

Growth of Mechanical Stoking of Locomotives.—It was inevitable that when a satisfactory mechanical stoker for large locomotives was developed, it would have extended application. We are informed by one large locomotive stoker company in this country that it has at the present time over 400 stokers in regular operation on locomotives in the United States, and that 200 of these are in use on the Baltimore & Ohio Railroad.

Final Blast in Aqueduct Tunnel.—The blast which removed the last barrier in the Catskill aqueduct tunnel was made by the Mayor of this city on January 11th. The tunnel extends uninterruptedly from the Ashokan reservoir in the Catskills to the terminal shaft in Flatbush. It now remains to be lined throughout with concrete, and when the control apparatus has been installed, the aqueduct will be ready for use.

Deaths From Automobiles in New York City.—The Report of the National Highways Protection Society shows that 25 persons were killed by automobiles in New York city in December. This brings up the total for the year 1913 to 302 fatalities in this city, of which number 149 were children. In the State of New York, outside of the city, the totals for the year are: automobiles, 150; trolleys, 79; wagons, 32.

Largest Pelton Wheel in Switzerland.—The hydraulic plant situated on the Lontsch River in Switzerland is now using what is claimed to be the largest Pelton wheel in Europe, the wheel being of 15,000 horse-power capacity. In the same station there are already six Pelton wheels of 6,500 horse-power, so that the addition of this latest wheel brings the output of the Lontsch plant up to 54,000 horse-power and makes it one of the largest plants in Switzerland.

Completion of Mt. Royal Tunnel, Montreal.—On December 10th, 1913, after fifteen months of tunneling through 3 1/10 miles of rock, the railroad tunnel under Mt. Royal, Montreal, was completed. This establishes a record for tunnel building through such material in America. The work was done by the Canadian Northern Railway Company. The excavation of Swiss tunnels has been done in less time, but generally the rock encountered was not so hard as that at Mt. Royal. The present inside measurements of the tunnel are 8 x 12 feet. When the work is completed it will be enlarged to 22 x 30 feet to accommodate two tracks.

Lofty Cantilever Bridge.—A lofty bridge of the cantilever type has recently been completed for the National Railways of Mexico over the Rio Chico on a new line between Durando and Llano Grande. It was planned at first to build a steel viaduct over the ravine, but later the engineers decided to construct a single track cantilever bridge. This structure has anchor arms, 105 feet long, and cantilever arms, each 135 feet in length, carrying a suspended span of 120 feet. The total length of the bridge between back walls is 701 feet 6 inches. The base of the rail is 244 feet above the bottom of the ravine.

Ocean Voyage of Submarines.—The four submarines which left Cuba on December 7th, proceeded under their own power to Cristobal at the Atlantic end of the canal. This trip (700 miles in the open sea) marks an advance in the navigation of submarines. The sea was rough under the influence of strong trade winds during the entire journey, but the boats found no difficulty in maintaining their speed and position for the five days consumed on the trip. The officers and men at the conclusion of the voyage were in as good, if not better, condition than at the outset. The submarines arrived with their fuel bunkers half full.

Gatun Lake Reaches Its Full Height.—On December 27th last the elevation of Gatun Lake was 84.76 feet above sea level, which means that it was practically at its normal height. On December 29th one gate of the Gatun spillway was left open throughout the day, and the outflow lowered the surface of the lake to elevation 84 above sea level, at which it will be held until the raising of a low spot at Cano Saddle is completed, and it becomes possible for the lake to rise to its maximum height. All the fourteen gates of the spillway were raised and lowered smoothly, and the tests were regarded as thoroughly satisfactory.

Sanitary Engineering at Harvard University.—Four new courses are offered by the Department of Sanitary Engineering of Harvard University. One will deal with the study, preparation and interpretation of vital, social and sanitary statistics, with special emphasis laid on their application to public health. Another deals with the principle and practice of sanitation and hygiene as applied to the farm, at the summer resorts, in camps, etc. The third course is for students who have never studied bacteriology and who wish to gain a general understanding of the relation of bacteria to the processes of nature, to chemistry, to sanitary science, and to health. A fourth course for specializing in government and business administration deals with the principles of municipal sanitation and sanitary engineering, with special reference to their administration in cities.

Science

A Uniform System of Shorthand in Germany.—For some time a movement, under government auspices, has been on foot in Germany to unify the various systems of stenography now in use in that country. A committee of 23 experts is now examining proposals submitted by representatives of 40 different systems.

The Antarctic Expedition under J. F. Stackhouse, which is to sail from England next summer, proposes to explore the little-known region between Graham Land and King Edward VII. Land, beginning at the former, and working along the coast, so far as ice conditions may permit. The expedition has opened headquarters in London, at Sardinia House, Kingsway, W. C., and is soliciting contributions.

The Classification of Stellar Spectra, as carried on at Harvard University, was described by Prof. E. C. Pickering at a recent meeting of the Royal Astronomical Society. The task in progress is a vast one, as it will entail the classification of perhaps 200,000 stars. However, about 500 spectra a month are now classified by Miss Cannon and her staff of assistants. Prof. Pickering also described the work of investigating some variable stars of remarkably short period; one of them doubles its light in seven minutes.

A Memorial to Baron Toll, the Russian explorer who, with six companions, was lost somewhere in or near the New Siberian Islands in 1903, is to be erected on the west coast of Kotelnyi Island, from which he embarked on the last known stage of his journey, viz., to Bennett Island. It consists of a tablet bearing a relief portrait of the explorer, with suitable inscription. General interest in Toll has recently been revived by the discovery on Bennett Island, by Lieut. Wilkitsky (or Vilkitskii), of the lost explorer's diaries and collections.

The Pellagra Investigation Committee, of Great Britain, has sent Dr. Louis Sambon to America to study this disease in the West Indies and the United States, with the aid of funds furnished by Mr. N. S. Wellcome and several West Indian governments. Dr. Sambon, who has previously investigated the disease in Italy, does not accept the common belief that pellagra is due to the consumption of damaged maize, but considers it an infection conveyed by an insect, viz., a Simulium, or sand-fly.

Land Reclamation in Holland, a task that has been prosecuted steadily for centuries with such indefatigable energy (the Hollanders boast somewhat irreverently that "God made the world, but the Dutch made Holland"), is still going on as actively as ever. From 20,000 to 25,000 acres of land are reclaimed every year. It is said, however, that more than 250,000 acres of the best soil is still under water, not including the great area under the Zuider Zee, the reclamation of which is a perennial topic of discussion.

The Drought of 1913 in the eastern and central United States was one of the most severe on record. In New York State, according to the *Monthly Weather Review*, the droughty summer was the most severe experienced in at least forty years. It was remarkable both for its duration and for the time of its occurrence, as it began to retard vegetation quite generally by the second week of June and, in spite of occasional rains, became gradually worse until the heavy rains of August 22nd–23rd. The failure of pastures and the drying up of wells and streams never before known to fail were reported from many parts of the State.

A New Idea in Weather Predictions is brought forward by Freiherr von Myrbach in the *Meteorologische Zeitschrift*. Every meteorologist knows that the coming weather cannot always be forecast with an equal degree of confidence; there are times when the current weather chart indicates the conditions that will prevail over a particular region twenty-four hours later with almost certainty, while, on the other extreme, there are weather charts from which prediction is little better than guesswork. The writer suggests that the public could use the weather forecasts more intelligently if the reliability of the latter were in some way indicated by the forecaster, and he suggests a numerical notation for this purpose.

The Crocker Land Expedition, commanded by Donald B. MacMillan, is now in winter quarters at Etah, Greenland, having been prevented by unfavorable ice conditions from crossing Smith Sound to Ellesmere Land, where it had been planned to establish the base. The vessel in which the expedition sailed from New York on July 2, the "Diana," was stranded on the rocks off Barge Point, Labrador, July 17. As she proved to be unfit for further service, the steam sealer "Erik" was chartered at St. John's to take her place, and a new start was made for the North on August 5. Along the Greenland Coast a number of dogs and Eskimo drivers were secured for the expedition. After disembarking the explorers, with their stores and equipment, at Etah, the "Erik" returned to St. Johns. An exploration of the Greenland ice cap is on the programme for the coming winter and spring.

Inventions

Sign-writing Made Easy.—With a view to simplifying and facilitating the preparation of signs and show cards by storekeepers and others, Sidney Hacker of Mt. Vernon, N. Y., in a patent, No. 1,063,969, provides an outline figure or figures suitably formed for manipulation by an unskilled person to aid one in quickly outlining letters or numerals.

A Reversible Moving Picture Film.—Charles E. Dresler and Isaac W. Ullman of New York city have secured patent No. 1,073,411 for a moving picture film which has one series of pictures running lengthwise of it and another series of pictures also running lengthwise of the film, but in the reverse direction, with the pictures of the two series upside down relatively to each other.

An Anti-suction Shuttle.—A patent has been granted to Edwin H. Ford of New Bedford, Mass., No. 1,071,039, for a band-threading anti-suction shuttle in which a downwardly inclined passage extends through the wall of the filling runway to the shuttle eye and acts as a vent to avoid the possibility of threading the shuttle by suction.

A Neck-tie that Can be Adjusted.—A neck-tie that can be lengthened or shortened is presented in a patent, No. 1,073,875, to John Calvin Stanford of Atlanta, Ga. The tie has a strip of rigid material secured by a single transverse line of stitching between the ends of the tie so that the material of the tie may be folded over the strip in different directions to effect different adjustments in the length of the tie.

An Electrically Heated Glove.—In patent No. 1,073,-926, to Anton Polak of Paris, France, is shown a glove which for the purpose of electrical warming has insulated flexible conductors which serve as heating bodies and are arranged loose alongside of each other and fastened at only a few points to the glove so that their freedom of movement is preserved as far as possible and the extensibility of the glove is substantially undiminished.

An Ozonizing Apparatus.—A patent has been issued to the administrators of Edward Charles Spurge of Niagara Falls, for an ozonizer, whose casing is hollow and constitutes one of the electrodes and is combined with a unitary structure consisting of two dielectrics and an electrode between them, with the unitary structure clamped between the casing parts to provide gaps on each side of the unitary structure.

Applying Wall Paper by Machine.—Patent No. 1,071,-812 has issued to Christian J. Siebenhaar of Oramel, N. Y., for a wall papering machine in which an extensible frame is provided with means for extending and collapsing it and paper and paste applying mechanism are supplied on a holder, together with devices carried by the extensible frame for pasting the paper on a wall or ceiling.

Some Hydrocarbon Burner Patents.—A series of seven patents, Nos. 1,070,603 to 1,070,609, both inclusive, have been issued upon the invention of Walter E. Huenefeld of Cincinnati, Ohio, for improvements in hydrocarbon burners having wick tubes and for laminated shells forming combustion chambers. Patents Nos. 1,070,608 and 1,070,609 have been issued directly to Mr. Huenefeld, while the other five are to the Huenefeld Company of Cincinnati as assignee.

An Electrically Operated Safety Razor.—Sampson W. Moon of Chicago, Ill., has patented, No. 1,072,634, an electric safety razor in which the razor head and blade are actuated or vibrated from side to side by electricity, which may be derived from the ordinary lamp socket. The vibrations are lengthwise of the blade so that as the razor is drawn over the face during shaving, the frame and blade are moved rapidly sidewise, giving a saw effect and aiding materially in the cutting of the beard.

A Novel Liquid Meter.—The Leinert liquid meter is an automatic measurer for water, petroleum, sugar juice and other liquids, measurements being made by weight and not by volume, so that temperature does not enter in. It consists of a pair of equal-sized tanks so arranged that when one is filled up to standard level it automatically shifts the feed over to the second tank and is then emptied by siphon recording at each time of filling and emptying. Being actuated by weight of liquid, it is not subject to the sudden inaccuracies of volume meters, and has scarcely any wearing parts. It can also be quickly cleaned and sterilized.

Prize Offered for Improved Horseshoe Design.—It is worthy of note, as probably affecting the roads over which they roll, that the British Roads Improvement Association has offered a prize of £100 for a new or improved type of horseshoe that will provide horses with a satisfactory foothold upon the modern smooth pavements and minimize the damage caused to such surfaces by existing types of shoes. The prize-winning type is to be evolved from open competition. Copies of the rules covering the contest may be obtained by addressing Mr. Wallace E. Riche, secretary of the R. I. A., whose office is at 15 Dartmouth Street, Westminster, London, S. W. There is no entrance fee.

Cleaning Silverware

By L. V. Redman

THE discovery and recent perfecting of electric silver cleaners mark a distinct advance in the art of silver polishing.

Silver polishes and cleaners have consisted until very recently of materials which dissolve off the tarnish or cut it off by rubbing with fine powders. The black oxide or sulphide which forms as tarnish upon the surface of polished silver appears at first as a film so thin that it displays beautiful iridescent colors of purple and blue; the thickening of the film produces the black oxide color. Solvent polishes are composed of chemicals such as ammonia and cyanide of potash. These chemicals dissolve off the black coating and leave the silver a beautiful satin finish on the surface. The cyanide polishes are very poisonous and should be used only with the greatest caution.

Abrasive polishes are composed of very fine powders and are designed to cut away the tarnish. The powders are very hard materials, such as, for example, tripoli, rouge, double floated silica, volcanic ash, kieselguhr, fuller's earth and pumice. Each particle as it passes over the surface of the silver cuts off a small part of the tarnish coat, the scratch being too small to be seen by the eye without the aid of the microscope. This method of cleaning silver is very wasteful, as it not only destroys the tarnish, but also destroys or wears away the silver. However, it is the only method which will give to silver that excellent, burnished shield effect, which at times is so much to be desired.

New electric silver polishes are being introduced to the public. They are designed to take advantage of the electric current which exists between two metals, when these metals are in contact with each other in water. The electric current, which is produced when two metals are in contact in water, is much stronger if an electrolyte like washing or baking soda or common salt be added to the water. The potential is further increased if the water be brought to boiling. Early attempts to make these polishes a commercial possibility were unsuccessful, for the metal used was tin. The water and soda were put in a tin pan and the liquid was brought to boiling. The silver articles to be cleaned were placed in the pan, immersed in the boiling water and in contact with the tin dish. When the pan is new the silver is cleaned rapidly, but the tin soon dies or becomes passive, that is, covered with an insoluble film of tin oxide, which will not conduct the electric current. Once the tin pan becomes passive, it is thrown away and a new one takes its place. The fault never lies with the powder. The powder is invariably soda or soda mixed with a little common table salt.

With the introduction of aluminium kitchen utensils another method was adopted for cleaning the silver. The aluminium dishes were used in place of the tin. The voltage is much higher between aluminium and silver; the cleaning of the silver is the matter of a moment if a spoonful of soda be added to the boiling water. The pan will clean the silver if the silver is left in cold water in the pan over night. However, this method of using aluminium utensils is not to be recommended, as the vessels are soon blackened on the inside and the aluminium ware is dissolved away by the soda and destroyed.

Aluminium dishes have been made and patented, for the special purpose of serving as silver cleaners. These boxes or pans are fitted at the bottom with rods of zinc which serve as an electric contact between the aluminium and the silver articles. The pans or boxes work fairly satisfactory, and because the zinc rods serve as conductors, they do not go passive or dead as the tin is inclined to do.

Another form of electric polish has been introduced into the market very recently which for cheapness and efficiency is at present unequaled. The powder is put in small packages and is accompanied by a sheet of metal which is an alloy of aluminium and other metals higher in the electric series. All that is needed is a vessel of granite, iron or tin in which water may be boiled. The powder is put into the boiling water and the sheet of metal is thrown in among the silver articles which are being cleaned. The only precaution necessary is to take care that the piece of metal is in contact with the silver. The cleaning is done in a moment and several pieces of silver may be cleaned at the same time. As soon as the cleaning is accomplished the metal should be taken out and washed in hot water and dried, if the best service is to be obtained from it. As these silver cleaners are composed only of washing soda and salt, there is nothing in them injurious to health. The silver after cleaning should be washed in pure hot water and dried, otherwise it may have a slightly yellow color and taste bitter or brassy. These effects are due to the soda which remains upon the surface of the silver and tarnishes it yellow. These electric polishes do not dissolve the tarnish of silver as ammonia and cyanides do. Nor do they wear off the coating of black as the rubbing powders do. The blackened silver is actually reduced to bright metallic silver by this method and is replated upon the silver article. Thus the silver surface is preserved and the life of the silverware prolonged indefinitely by this treatment. Laboratory tests have shown that silver vessels placed in sulphur or sulphides until the silver is blackened and then cleaned by this electrolytic method, do not lose enough silver in one hundred treatments to be detected with a scale which weighs accurately to one two hundred and fifty thousandths of an ounce. The rapidity of the cleaning, the simplicity and the cheapness of the method, and the saving on the silver, should recommend the method to every one interested in silver cleaning.

Tarnished silver partly cleaned by electrolytic process.

Cleaning a knife by immersing it with an aluminium rod in a hot soda and salt solution.

An Electrical Automobile Transmission System

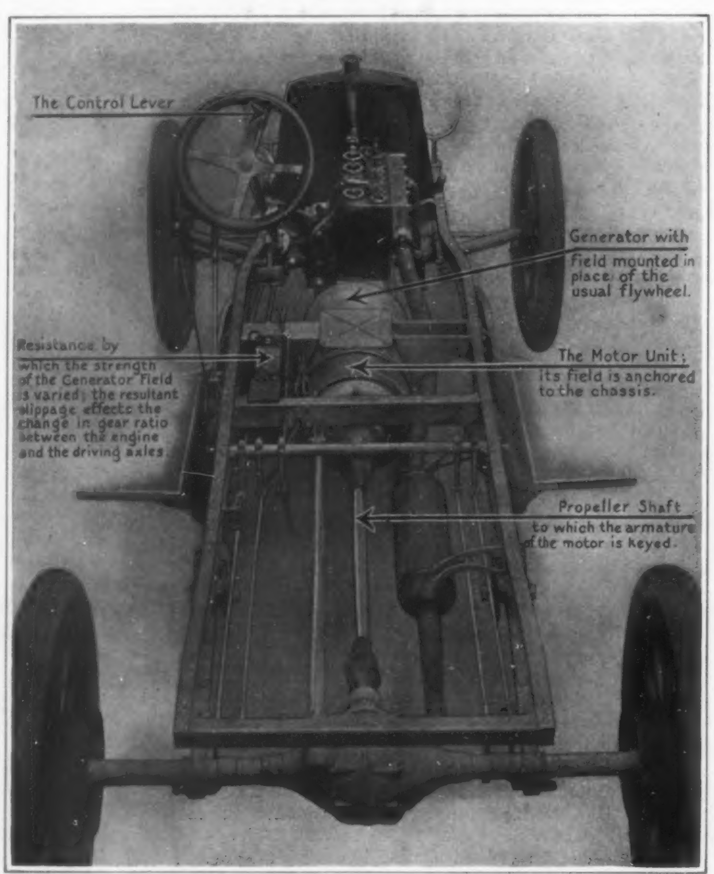
By Ross Babcock, M.E.

THERE appeared at the recent automobile show in Grand Central Palace in New York a radically new type of electric automobile transmission. Aside from performing the functions now performed by the latter-day type of electric engine starting system, the new apparatus eliminates the usual type of master clutch between the engine and the remainder of the propelling mechanism as well as change gear set and engine flywheel. Thus it substitutes for clutch and gearset and flywheel and engine starter and their various controls, a single unit with a single moving part and one control lever. With that single control lever it is possible to obtain seven variations of ratio between the speed of the engine crankshaft and that of the driving axles.

In its simplest aspect, the new system consists of a compact generator, a series-wound motor unit and an 18-volt, 35-ampere hour storage battery. The battery can be eliminated, for no reliance is placed upon it for the operation of the transmission; it serves merely as a source of current for starting the engine and for carrying the lamp load as in the ordinary electric lighting and engine starting system.

The generator portion of the system has its field mounted in place of the usual engine flywheel which thus is eliminated. The armature is keyed fast to the propeller shaft. The motor unit is mounted just back of the generator with its armature also keyed to the propeller shaft, but with its field securely anchored to the chassis frame. The whole, generator and motor, is completely inclosed in a tight aluminium housing, as is shown by the accompanying illustration, and therefore is thoroughly protected from the insidious action of dirt and moisture and from accidental injury.

The principle of operation can be described briefly as magnetic drag. When the engine is started, the rotating field of the generator exerts a certain drag upon the armature which thus is rotated, carrying with it the propeller shaft and moving the car. The slippage between the field and the armature of the generator is controlled by the simple expedient of varying the strength of the field partly with the aid of resistance, and it is this slippage that affords the change in gear ratio between the engine and the driving axles. Obviously, the slippage results in the generation of a certain amount of current which ordinarily would have to be absorbed by resistance and thus be lost in heat. It is here, however, that the motor unit assumes the place of importance it occupies in the system. Instead of being lost in resistance, the generated current is passed to the motor, which thus becomes a source of energy and assists in propelling the car.



This electrical transmission performs all the functions of an automobile engine starter and eliminates the clutch, changes gear set and flywheel.

When the car is first started—with the control lever in the first speed position—the slippage is at its maximum and hence the maximum amount of current is passed to the motor, the result being that we have a comparatively high torque for starting when it is most needed. As the speeds are "notched up," the motor gradually is cut out of the circuit until at what in the average automobile corresponds to high gear, the motor is virtually dead.

With regard to the amount of slippage that takes place at what may be termed the "high gear" position—and hence the efficiency of the mechanism—it is stated that with the engine crank-shaft rotating at 1,000 revolutions a minute, the speed of the armature will be approximately 960 revolutions a minute. In other words, with the car running on a level road, there is a loss of about 40 revolutions a minute between field and armature. On steep hills, or in sand or mud the slippage may be expected to increase slightly. A fair average would place the efficiency at from 93 to 96 per cent.

As there is no mechanical connection between the engine and the propeller shaft it is evident that an extreme degree of flexibility in the drive must result; it is impossible for engine impulses to be transmitted—a car will run as smoothly, in fact, with three of its four cylinders working as it will with them all firing—

(Concluded on page 90.)

Wireless Time

An Interesting Experiment Made at Beloit College

By Dr. E. A. Fath, Director of Smith Observatory

Fig. 1.—The sidereal clock. Note the massive stone pier to which it is attached. Rigidity of support aids in having a clock run uniformly.

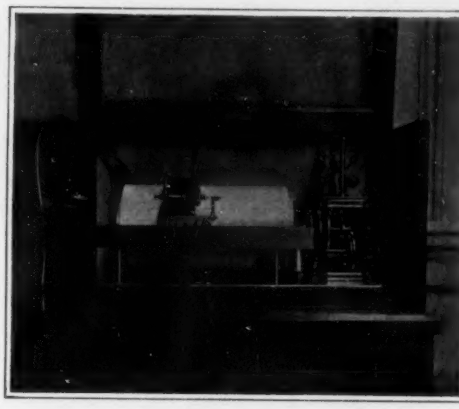


Fig. 2.—The chronograph, for use in recording the instant of a transit.

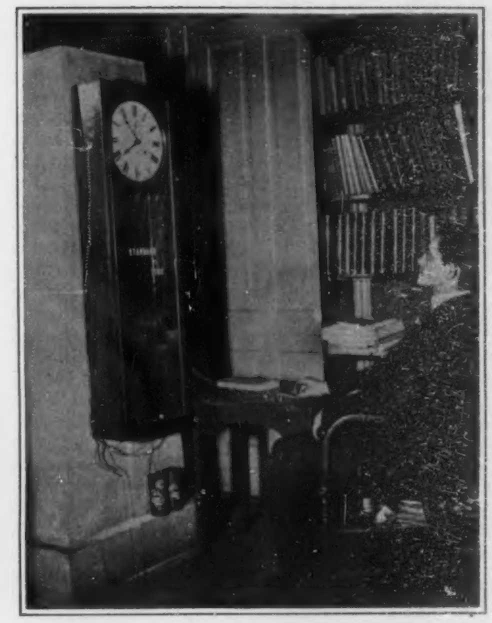


Fig. 3.—The standard time clock. The observer is ready to cut out the required beat during the sending of the signals.

Fig. 4.—The transit instrument. The observer has the chronograph key in his hand to record the time of star transits.

Fig. 5.—The wireless transmitting equipment. The last switch is being thrown before time signals are sent out.

THE determination of time is one of the very practical aspects of astronomy and many observatories are engaged in it to some extent. Up to the present time, it has always been necessary to have direct wire communication with an observatory in order to obtain essentially correct time, but with recent developments in wireless telegraphy the metallic circuit is no longer needed. It is therefore possible for anyone equipped with suitable receiving apparatus to obtain correct time provided some observatory can deliver the proper signals to a wireless transmitting station. Co-operation of this kind has been established in France between the Paris Observatory and the Eiffel Tower radio station, and similar combinations are reported at other points in Europe. So far as known, however, the service to be described in this article is the first serious attempt in this country to send out regular time signals by means of electric waves. The plan originated with Dr. C. A. Culver, Professor of Physics in Beloit College. After he and the writer had carefully gone over the situation and tried out various schemes, the present plan of procedure was adopted. It is the purpose of this article to describe briefly the methods employed.

There are in the sky some hundreds of stars whose positions have been very accurately determined by observations extending over many years. Owing to the rotation of the earth on its axis, stars cross the sky during the night just as the sun does in the daytime. Since the position of these selected stars has been so carefully determined, it is possible to tell with an accuracy of about one one-hundredth of a second when any one of them should cross the meridian, or north-and-south line, of any point whose longitude is known.

In order to utilize these stars a telescope, usually called a "transit instrument" (Fig. 4) is set up so that, as nearly as possible, its line of sight sweeps along a true north-and-south line in the sky. In order that this telescope may be as stable as possible it is placed upon a heavy pier of brick and stone which is built up from a level five feet below the ground level. At the bottom this pier measures 5 by 6 feet and tapers upward to a capstone 2 feet 8 inches square. When this telescope is set for a certain star, the latter, at the proper time, can be seen to come in at one side of the field of view, gradually cross it and finally disappear on the other side. In the field of view, which is faintly illuminated, there can be seen a series of spider threads arranged as shown in Fig. 6. The middle thread is placed as nearly as possible in the center of the field, and, if the instrument is in absolute adjustment, the star crosses the meridian in the sky at the same time it crosses the middle thread. Knowing the exact position of the star, we therefore know the time of transit.

It then becomes necessary to record this instant. This is accomplished by an instrument called a chronograph (Fig. 2). It consists essentially of a rotating cylinder carrying a sheet of paper and a pen which traces a line on the paper. The astronomical clock (Fig. 1) of the observatory is electrically connected with the pen and causes it to break the continuity of the line at each beat (Fig. 7). By means of a telegraph key the observer at the telescope can cause a similar break whenever the star crosses a spider thread. After identifying the various minutes and seconds on the paper it is possible to determine to about one one-hundredth of a second when the observer made the additional break. This time, however, is the clock time. If the record on the chronograph sheet shows the same time as the instant when the star should be on the meridian then the clock is correct, while if not, the difference is the amount the clock is in error.

The actual scheme of observation, however, is not quite so simple as that outlined above. The telescope may not be precisely in the meridian, one end of the horizontal axis of the telescope may be a very little higher than the other, the line of sight may not be exactly at right angles to the axis, the observer may not press his key with sufficient accuracy, etc.* Accordingly, it is necessary to determine whether any of these sources of error exist, and, if so, how much they affect the result. It is therefore customary to observe the transit of a star over a number of the spider threads and also to use from 6 to 10 different stars. Then, by averaging the results, it is possible for a good observer with first-class instruments to determine the error of his astronomical clock to about one one-hundredth of a second.

The time thus obtained is "star" or sidereal time, and the astronomical clock which keeps this time is called a sidereal clock (Fig. 1). Such a clock is always the best in the observatory for it must be depended upon to run with great accuracy during periods of cloudy weather when it is impossible to check it by means of the stars. The highest grade clocks of this kind can be depended upon to one tenth of a second per week. Some have been known to do even better than this.

The average man, however, is not interested in sidereal time, since it is not of direct value to him. What he wants is solar time, and, more particularly, standard time which is now used in almost all civilized countries. It is therefore necessary to change sidereal time into standard time. This is easily accomplished by means of suitable tables and a moment's calculation. Then another clock, the standard time clock (Fig. 3) is set to show this time. This clock need be only a fair time keeper, for it can be compared with the sidereal clock and any error easily corrected. At this observatory it is our policy to make such a comparison and set the standard time clock correct to about one tenth of a second just before the daily time signals are sent out.

By means of a simple device, the standard time clock is made to operate a telegraph relay in such a way that each time the clock beats, a circuit is closed, and thus the relay ticks with the clock. This relay, which appears at the right in Fig. 3, is connected by wire to a similar instrument which controls the wireless apparatus of the department of physics in another building.

The accompanying engraving (Fig. 5) shows the radio-transmitting equipment. *A* is a high tension transformer. This is supplied with alternating current at 110 volts and having a frequency of 60 cycles. The transformer changes the voltage to about 30,000 and charges the high tension condenser, *B*, seen at the right. This condenser discharges through the usual spark gap and oscillation transformer *C*. The last device changes the frequency from sixty to several hundred thousand per second. The aerial from which the electric waves are radiated into space is 400 feet in length and is connected to the oscillation transformer.

We thus see that the standard time clock at the observatory controls the current which actuates the high tension transformer and therefore the output of electric

*As a matter of fact, it is utterly impossible to keep a transit instrument in absolute adjustment. Slight differences of temperature cause varying expansion or contraction of the pier and thus throw it out of level, etc.

waves. Each beat of the clock causes a train of waves to be radiated into space. Each group of waves is heard as a single dot at a receiving station so that it might be said, almost literally, that at each station the clock is heard to beat.

The plan of sending time signals which has been adopted for the present is as follows: Each afternoon beginning at 2:55, the clock beats are sent out. The beat is omitted on the 59th second of each minute up to 2:59:56. A break of ten seconds duration is then made which is terminated by a single beat. This beat therefore marks 3:00:00 P. M., and may be considered the essential signal, the others being merely preliminary.

After the switches are thrown at 2:55, everything has been arranged to proceed automatically with the exception of the breaking of the clock circuit for the omitted beats. In a short time this too will be automatic.

For the present, the transmitting equipment is good for about 150 miles during the day, but various changes now under way will greatly increase the range.

One of the advantages of wireless service of this nature is the freedom from interruptions which are common to ordinary wire telegraph systems because of storms, etc. The system is practically independent of weather conditions. It has been in operation since November, 1912, without interruption.

One of the purposes in taking up this work is the collection of data relative to radio-telegraphy by Prof. Culver, from a large number of receiving stations within our radius, which have agreed to furnish periodical reports. It is believed that data of some value can be secured in this way. Time is also being furnished to jewelers and manufacturers who need correct time.

The extended use of wireless time transmission will be of great value throughout the world. While its use on land may become very extensive, yet its principal value will doubtless be on the oceans. On shipboard it will be possible to obtain chronometer corrections to a high degree of accuracy, and this, in turn, will increase the accuracy with which the vessel's position is known. Such knowledge will be of value for charting purposes as well as in times of disaster, when it may mean the difference between life and death.

Recent Improvements in Aeroplane Design and What They Mean

By C. Dienstbach

ALTHOUGH there was seemingly a reason for the complaint that the recent aeronautic "Salon" in Paris showed too little progress, a closer inspection of the fifth of the great French aero shows fails to bear it out. It is true that a weeding-out process has started. The industry has settled down to the practical basis of catering primarily to military requirements, and the number of exhibitors has diminished.

The businesslike apparatus shown gave better proof of real progress than the freaks of former years. While types looked familiar, details of construction had all been developed from long experience in the exacting and practical flying demanded by the military authorities, and designs showed the work of the modern aerodynamical laboratory. This stamps as "practical" some entirely new departures, which looked too modest to command widespread attention, but were really of singular importance. Although inspired by military demands, they will eventually go far in commercializing the aeroplane by making it safer. Thus, an 80 horse-power monoplane ("De Beer") and a 160 horse-power biplane ("Paul Schmitt") were each provided with a perfected mechanism for changing the angle of the planes with the line of the propeller thrust and the fuselage during flight, for the purpose of being able to fly very slowly while making minute observations or dropping bombs and landing on difficult ground. Although any aeroplane can change its angle of attack by operating the horizontal rudder, this primitive method changes the line of the propeller's thrust just as much. The "slipstream" is then turned into a strong descending current which disturbs the normal action of the planes and rudders and impairs their lift. While the propeller itself becomes somewhat lifting, more harm than good is done, because at the steep angle of the planes every ounce of thrust is needed for propulsion. If fast flying did not waste so much power in overcoming the head resistance of struts and wires, which becomes clear gain with that resistance diminishing out of all proportion while flying slowly, the English War Office's prizes for moderately reducing the speed at will could never have been won by the machines competing. (Even the Gordon Bennett aeroplane race is now open only to such fast machines as can likewise cover a slow lap around the course.) With the new arrangement, a speed range of from 19 to 75 miles an hour is claimed for the big biplane.

In landing, the advantage of this arrangement is very obvious. At present the speed must be checked at some altitude when it is still needed for fighting the treacherous gusts of the lower air and in steering around obstacles. It cannot be checked instead just before touching ground (as the birds do) because the long fuselage is in the way. Nor can the machine's rolling after touching be quickly stopped without danger of a somersault while braking on the wheels or on the ground. The new arrangement, supplemented by a reversible propeller, permitting intense aerial braking, would easily provide for birdlike landings on any circumscribed area.

It is most significant that the famous designer of propellers, Chauvière, has brought out a propeller, the pitch of which can be changed during flight. It is only a matter of degree to make it entirely reversible. But before slow flying can reach its full development adjustable planes must be supplemented by changing the propeller's pitch, as actually provided for by Chauvière. It is a well known fact that a motor never develops its maximum number of revolutions while the machine is held stationary on the ground, yet could do so if the propeller's pitch were reduced for so long. The pitch must likewise be reduced lest the motor should become powerless in urging the machine against the excessive resistance of the steep planes. Even so, it needs a reserve of power, but surplus power is now so clearly recognized as a necessary condition of fighting the vicissitudes of the air with the primitive machines of to-day, that not a single French aeroplane now lacks a large margin of it. The new arrangements will rather tend to decrease the needed amount. They include also a larger size of propeller, lest in flying very slowly the slip should increase unduly. This requires in turn the efficient gear-drive shown in Caudron's large "seaplane." One of the "baby" Wright racers of 1910, with its enormous twin propellers, furnished a striking proof of the lifting power of a steep angle of the planes, supplemented by suitable propelling arrangements (behind the planes, beside the tail, and with a slow slipstream these large screws impaired the lift but little) when it established a height record in spite of small surface and was seen to start with the shortest run. Very slow flying obviously also demands enlarged rudders.

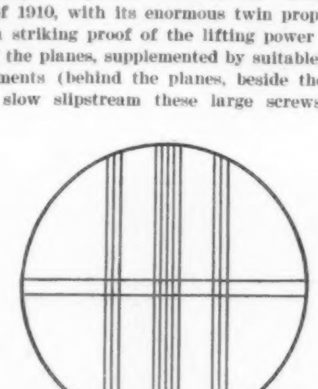


Fig. 6.—The spider threads of the transit instrument. The star is kept between the two horizontal threads so that each star is observed in the same part of the field of view.

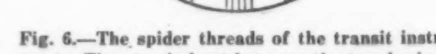


Fig. 7.—Part of a chronograph record. The consecutive numbers mark seconds. Two additional signals made by the observer at the transit instrument are shown.

The capacity to fly very slowly and fast at will provides more important advantages than the purely military ones. It permits starting with a very short run (little inertia needs to be overcome to raise the machine) and landing almost without any run. An aeroplane capable of starting and alighting on the roof of an ordinary house certainly goes a long step toward attaining the commercial machine of the future. But still better, it will eventually rob "stalling" and the "airhole" of their terrors. In descending currents a steep angle of attack will supply that sudden increase of lift a gull derives from its characteristic "periods of vigorous flapping." Getting more or less "stalled" means nothing to a machine capable of very slow flight, because little inertia needs to be overcome before it can lift and balance again.

Prize for a Non-Rubber Automobile Tire

THE Austrian War Department offers $10,000 as a prize to be awarded to the person who will, with adherence to certain prescribed conditions, construct an elastic tire for motor trucks. Besides the specific attributes of pure rubber, such as elasticity and adhesiveness, the new material must possess (1) essentially greater durability, or (2) with equal durability the attribute of essentially smaller cost of construction than the rubber tires, thereby reducing the expense of operating motor freight wagons. Its weight must not exceed that of the pure rubber tire. Competitors should hand in a model of the fabric in natural or reduced size, together with drawing and description, at latest by June 30th, 1914, at the *Automobil-Versuchsabteilung* (Automobile Trial Division), VI. Gumpendorferstrasse 1, Vienna. Further details may be found in the *Militärische Rundschau*, published at I. Graben 23, Vienna, and to be had also on application in German to the K. K. Kriegsministerium, Vienna, Austria.

The Introduction of Deodar Cedar and Its Uses

THERE are few trees about which there is so much curious information as the true cedar of the Himalayas. It is called the deodar cedar, and is said by some botanists to be merely a variety of the cedar of Lebanon (*Cedrus libani*). The loftiness and spreading branches of this tree accord exactly with the description of the cedar of Lebanon mentioned in the sacred writings. The principal difficulty with reference to its being identical with the true cedar of Lebanon is that it is not found at present on, or near, Mount Lebanon. This does not say that it did not grow there in abundance formerly and subsequently disappeared. In India the tree is held sacred, and in some places it is not cut except on special occasions, and then only for its wood for incense. The Hindoos call the tree *devadera*, which means the tree of God.

It is a very large tree, often attaining a total height of from 100 to 150 feet and a diameter of from 10 to 12 or more feet. It has a life equally as long as the *Sequoias* and is tolerant to a marked degree of adverse conditions. It is one of the most drought resistant trees known, and will do better in poor, shallow soil than any other tree that can be made to grow. The deodar is sufficiently hardy to thrive in any part of the United States south of Delaware except at great elevations. Much encouragement has recently been given to its propagation in California, both for shade and ornament and for its timber. In southern California this tree is thriving at points where the thermometer often goes as low as 12 degrees above zero. One thousand deodar cedars have recently been purchased by the city of Los Angeles and planted in Elysian Park, where they are doing well. The city has thus far planted altogether about 10,000 trees of this species in Elysian and Griffith Parks.

About the year 1850 the English government imported an enormous quantity of seed from India and placed it in the hands of nurserymen, to cultivate, on condition that they should return one half of the product to the government at the end of three years. By this means about a million young seedlings of this very valuable tree were planted in England. This is an example well worth following in this country. The establishment of deodar plantations in favorable localities along the Atlantic seaboard of the southern States would serve as a splendid object lesson for those who wish to plant a valuable tree on land that is unfit for farm crops.

The deodar is planted extensively both in India and in Europe, not only because of its very great ornamental value, but also because of the superiority of its wood, which is compact, resinous, highly fragrant, of a deep rich color sometimes resembling polished brown agate. It is also of the most durable nature, instances being on record where its timber, employed in the roofs of buildings, was found perfectly free from decay after a period of nearly two hundred years. The records show that one piece of deodar used as a part of an old bridge in Cashmere, India, at the end of four hundred years proved to be very little decayed, although it was exposed to the action of the water. Pillars of it in the great mosque are said to be of the year 804 Hijri, and those on the Hindu temples are from six to eight hundred years old. Insects do not attack it. It is strong, elastic, and the average weight is only about 35 pounds per cubic foot. The wood has a remarkably fine, close grain, capable of receiving a very high polish, and in India is used for a great variety of purposes. It is used most extensively in the construction of houses and is regarded as one of the best woods for boat and bridge building. It is particularly desirable for the roofing of houses. The wood is very resinous, and is often cut into strips and used as candles.

A New Idea in Moving Pictures

POWERFUL arc lights combined with newly designed moving picture apparatus are used at the Scala Theater in London to produce some wonderful effects, for the persons are seen in life size moving about without the use of any visible screen, so that they appear to act upon a real theater scene which is lighted as is customary in such cases. This remarkable result is brought about by optical combinations which have as yet not been made public. The illusion is heightened by electric devices of an improved kind for working a phonograph together with the moving picture machine so that it always keeps in step, and the words or music are reproduced at exactly the same time as the gestures. It is said that the new apparatus does this with great perfection.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Architect of the Fisheries Building at the Panama Exposition

To the Editor of the SCIENTIFIC AMERICAN:

In the World's Fair article contained in your valued issue of the 6th ult. I observe that the writer accredited me with having been the "architect" of the Fisheries Building at the World's Columbian Exposition.

As this was in error I desire that the wrong impression be corrected as far as possible, insomuch as Mr. Henry Ives Cobb was architect and I served as designer-in-chief for Mr. Henry Ives Cobb in designing the Fisheries Building, therefore Mr. Cobb should properly be accredited with having been the architect of the structure and myself as designer.

San Francisco, Cal. L. C. MULLGARDT.

Twenty-five Knot Battleships

To the Editor of the SCIENTIFIC AMERICAN:

As to 25-knot battleships, and your recent editorial as to same, you write: "The large amount of weight which must be allotted to the motive power in order to secure 25 knots might better be given to armor protection, or guns. This would be in line with the policy we have wisely and steadily followed, where the speed is moderate and the armor and armament very powerful."

Your article states also that the 25-knot battleships of the "Queen Elizabeth" class have 14-inch armor, and that our latest ships have 13-inch. The "Queen Elizabeth" and sister ships have 15-inch guns. The biggest gun we have afloat or under construction is 14-inch.

The British 15-inch gun weighs 87 tons; projectile, 1,950 pounds. Our 14-inch might be under 60 tons; projectile, 1,400 pounds.

The British ships are several knots faster than ours; notwithstanding this they have heavier armor and bigger guns. The inference in your article is that our policy is to sacrifice speed for heavier armor and bigger guns.

Facts show plainly that the British ships are not only much faster, but have heavier armor and bigger guns. To a layman it is apparent that our ships are badly behind our British cousins in all essentials.

Also read article in same issue of your paper concerning the British battle-cruiser "Princess Royal." And that the speed curves worked out prove conclusively that with the power, said cruiser speed could not have exceeded 30 knots.

We have authentic data concerning other battle-cruisers, including the British "Indefatigable" and "Lion" and the German "Moltke" and "Von der Tann," all of which exceed 29 knots, and going to upward of 33.

San Francisco, Cal. C. P. SLOSSON.

[A discussion of the comparative efficiency of the "Queen Elizabeth" and our latest battleships will be found on the Editorial page.—EDITOR.]

Bacterial Versus Inorganic Fertilizers for the Soil

To the Editor of the SCIENTIFIC AMERICAN:

Mr. C. Cahall, in his article on the ten greatest inventions, as published in the SCIENTIFIC AMERICAN SUPPLEMENT of November 15th, mentions the artificial fixation of atmospheric nitrogen, laying especial emphasis on its relation to agriculture. Mr. Cahall is evidently mistaken as to the field in which the discovery he names will probably find its usefulness; for whatever may be its importance in a military or industrial sense, it is certain that it has little agricultural importance. While it is true that nitrogen is a very important plant food, and a very expensive one if bought in the nitrate forms, it is also true that it is so easily supplied from the atmosphere and from decaying vegetation that farmers have ceased considering it among their fertilizer expenses.

In 1886 Hellriegel discovered that certain bacteria found on the roots of leguminous plants had the power to fix atmospheric nitrogen. All leguminous plants share this property. Without the bacteria peculiar to themselves they cannot flourish; with the bacteria they not only flourish, but the nitrogen fixed by bacterial action is, at least in part, immediately available to plants other than the legumes, growing in the same field with them. Given a soil in good mechanical condition, and containing the elements other than nitrogen, a leguminous crop will not only make a good yield, but will, when harvested, leave in the soil sufficient nitrogen to supply a succeeding crop of any other grain. It is a fact well known among orchard men that a crop of peas, beans or vetch planted between the trees will supply them with all the nitrogen they need by fixing it from the free nitrogen of the atmosphere.

Farmers know also that fallowing a field, but especially sowing it to any kind of grass, will result in an increase of soil nitrogen. It may be safely stated that, other things being equal, soil nitrogen is proportional to the humus content of the soil in question, as bacterial action depends largely on the decay of vegetable matter. The place of humus in soil management is too large a matter to be entered into here; but it may be said that without humus there can be little bacterial action, and consequently little fixation of nitrogen. The trouble with commercial fertilizers is that they do not supply humus, and that soil soon becomes mechanically unfit for crop production, and bacterial action stops altogether. This is especially true of the action of the non-symbiotic bacteria, the Azotobacters, which depend for their support upon the carbohydrate content of the soil in which they live. Lipman quotes Kühn as saying that, after growing non-leguminous crops on the same soil (sandy loam) for twenty years, the yields became no smaller, notwithstanding the fact that only non-nitrogenous fertilizers were used. Similarly, in a portion of the Geesecroft Field at Rothamsted, abandoned to itself between the years 1882 and 1904, and bearing no leguminous vegetation, there was an average annual increase of twenty-five pounds of nitrogen per acre. These experiments only confirm the experience of every farmer. The best results are obtained from the use of organic fertilizers, as bacterial action of all kinds is thus added.

In farm practice nitrification must be constant. The fugitive nature of nitrate compounds makes it practically impossible to use a sufficient quantity to feed a crop during the growing season, or at most more than a year at a time. On the other hand, atmospheric nitrogen, fixed by the soil bacteria, is constantly renewed and constantly available, but especially during the spring and early summer, when more nitrogen is needed than at any other time. The problem before the working farmer is not to find a new source of nitrogen, but so to manage his soil that he will tap the limitless supply in the atmosphere, and compel it to take its place in the life cycle of his crops, to be liberated and used again and again in the generations to come. Mineral nitrogen is expensive and often unsatisfactory; that derived from the atmosphere is usually a by-product of a profitable crop, and always leaves the soil in good condition. The nitrogen problem has no further meaning to the farmer. R. W. DAVIS.

Moline, Ill.

[We cannot agree entirely with the position taken by Mr. R. W. Davis. While it is perfectly true that a certain amount of nitrogen can be fixed by bacterial agents assisted if necessary by human aid, without the application of nitrogenous fertilizers to the soil, yet it is an undeniable fact that in the present order of things it is customary to apply such fertilizers to the soil, whether in the form of Chile saltpeter, ammonium, sulphate, or what not. Nor is it likely that these methods will ever be entirely supplanted by the bacterial method. For this last is necessarily somewhat slow in its action, and there are many cases in which immediate addition of considerable quantities of nitrogen to the soil is imperative.

Neither can it be said that Chile saltpeter and ammonium sulphate have in the past been applied to the soil merely because they happen to be convenient and available in a reasonably cheap form, and that this practice of using inorganic fertilizers will be abandoned if at any time the cost of Chile saltpeter becomes prohibitive. For at the present day, calcium cyanamide is actually marketed and put on the soil. The technique of cyanamide manuring is, in fact, at the present day well understood, and pretty thoroughly worked out. Cyanamide possesses many properties that render it highly desirable as a fertilizer. It forms an excellent dryer and conditioner when mixed with other fertilizing materials. At the same time there is one limitation to its use, namely, that in conjunction with superphosphates the proportion of calcium cyanamide permissible is limited by the fact that an excess beyond a certain amount tends to cause a reversion of the superphosphates. It may be stated that about 100 to 120 pounds of calcium cyanamide per ton is at present the maximum allowable for use in conjunction with superphosphate. If the phosphorus is applied to the soil in the form of steam-ground bones, somewhat more cyanamide may be used.

The application of nitrogen compounds to the soil directly and the fixation of nitrogen in the soil by the agency of bacteria each has its own special field of usefulness, and we can only gain by giving each of these methods the attention which it so well deserves. —EDITOR.]

The Current Supplement

THE current SUPPLEMENT, No. 1986, contains a remarkable number of readable and highly instructive articles. First of all Noel Deisch discusses the gyroscopic force in revolving cylinder motors and suggests how stability may be improved by altering the position of their axes of rotation.—How a Parsons steam turbine from one of the United States navy destroyers was rebladed is told by N. L. Mosher.—Dr. Felix Oswald's paper on "The Sudden Origin of New Types" is concluded.—To those who are interested in the technical aspects of Pégoud's flights we may commend a scientific analysis of that remarkable aviator's performances which appears in the current SUPPLEMENT. —W. F. Schulz describes stellar photometry by the use of the photo-electric cell.—"A Desolate Island in the Antarctic" is the title of an article by Robert Cushman Murphy, in which the great whaling grounds of South Georgia in the latitude of Cape Horn are picturesquely described.—Among the miscellaneous articles of interest may be mentioned those entitled "The Passivity of Metals," "Winter Troubles on Electric Railways," "Palæobotany: Its Past and Future," and "The Production of Animal Heat."

The Alliance Between Harvard University and Massachusetts Institute of Technology

IN the daily press there have already been set forth the outlines of the plan for co-operation in engineering studies between Harvard University and the Massachusetts Institute of Technology. These are in effect that for the four courses in applied science; namely, mechanical, electrical, civil (to which sanitary engineering is attached), and mining engineering (with which metallurgy is affiliated), Technology in its new plant beside the Charles will direct and actually conduct the studies and investigations, while Harvard will contribute of its funds. The University is to give up entirely its graduate schools of applied sciences (in these branches) and the funds now at their disposal will be paid out by the Bursar of Technology for instruction within Technology walls. The president of the Institute is to be executive head, and the Faculty of the Institute, the board to prescribe courses, etc. The latter is to be enlarged by the addition to it of the instructing staff of the University schools that are to be discontinued.

Efficiency is to be gained by this concentration of effort, an important step forward and in contrast to the prevailing educational custom in America of maintaining at great cost competing courses in the same departments in colleges that serve the same community. It is the community that pays for such things, and educational alliances mean material economies in cash besides those which the union of the faculties entails. With co-operation it is possible for the students of both institutions to have the advantages of strong men for instruction of a quality that it would be folly for each to maintain separately. The Tech.-Harvard alliance means a fuller utilization of the splendid men in both faculties for the benefit of the students in both colleges.

The general story has hitherto been of this nature, the benefit to the community. There is another phase which interests engineers, the question how the students are to be affected. The SCIENTIFIC AMERICAN is pleased to present this side of the case from President Maclaurin's address to the students of Technology at their recent convocation.

Here the terms of the agreement were commented on and three phases considered, the effect with reference to the corporation of Technology, the faculty and the students, respectively. The corporation will have from the outset a little more money to spend, though not much comparatively speaking. The annual income of Technology is about $700,000, and Harvard will contribute about one tenth as much. The faculty will be affected only by the addition to its number of a few members from Harvard, not many.

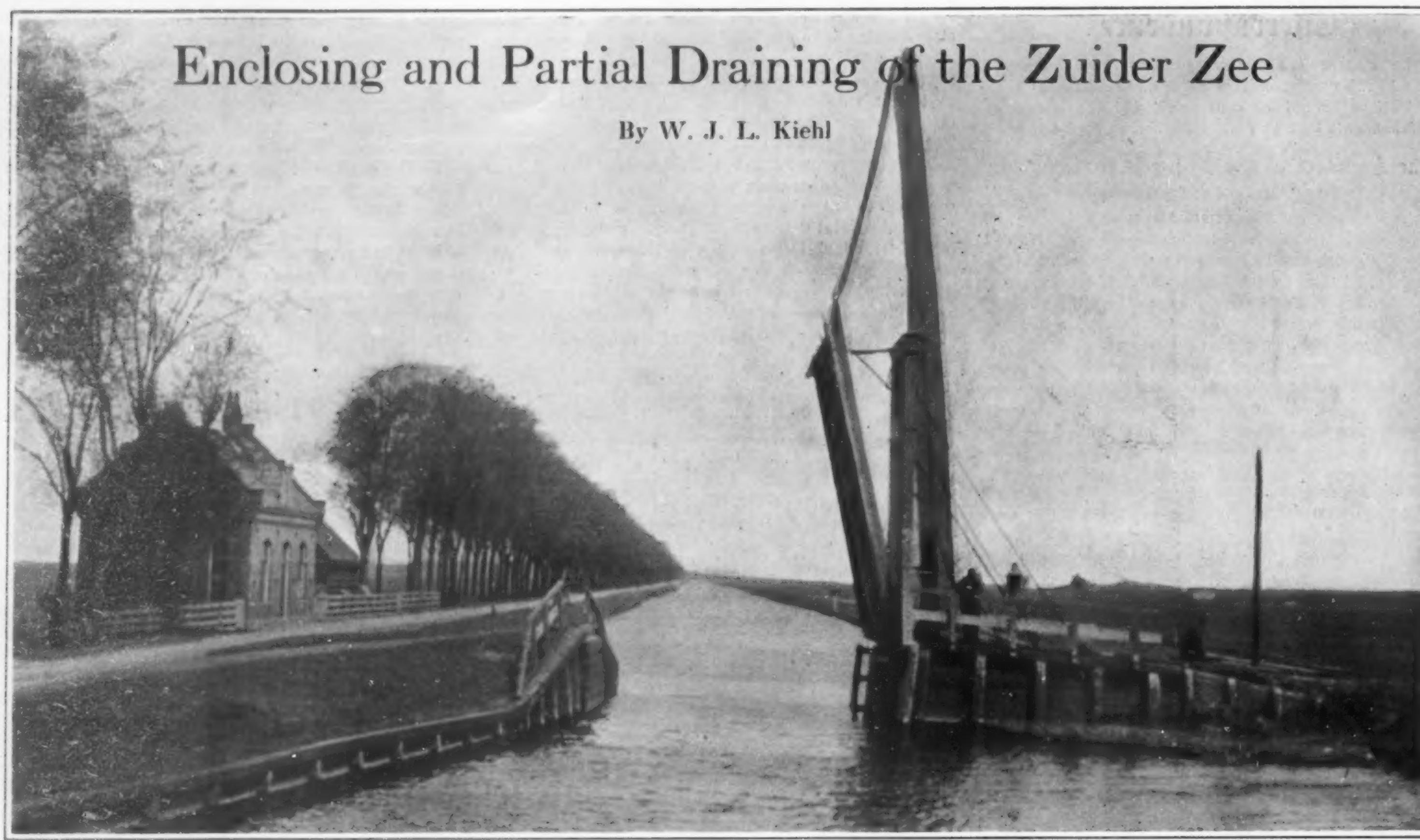
The students of Technology will be affected very little. All the men for the engineering courses will enter the Institute together. At a certain time, as now, the question will be asked as to what course is to be chosen. If this be an engineering course in any of the departments affected, the further question will then be asked, as to which course, Harvard or Technology, is to be taken.

The student pursuing the courses in the Institute alone will not be in any way affected. If he should designate that he intends to follow the Harvard course, or both, which is by no means out of the question, he will then have certain advantages. He can go into the museums of Harvard and study if he wishes. He will have the privileges accorded to students at the libraries of Harvard. Among the minor advantages will be the privilege of subscribing to the Symphony concerts in Cambridge, the use of the Stillman Infirmary (on payment of fee) and he can make use of the athletic field of Harvard. Among the important advantages will be the privilege of attending without fee certain Harvard lectures outside of the course selected.

Trunk Manufacturers in Colorado are abandoning the usual basswood and cottonwood for the trunk box, and are turning to Engelmann spruce, which combines lightness, strength, and ease of working.

Enclosing and Partial Draining of the Zuider Zee

By W. J. L. Kiehl



FOR the benefit of the numerous readers of the SCIENTIFIC AMERICAN, Dr. C. Lely, Netherlands Minister of Waterways, most kindly explained his project for the reclamation of the Zuider Zee to the correspondent of this paper. His Excellency also gave two maps annotated by himself for publication in connection with this article, from which our artist has prepared the accompanying bird's eye view, showing future conditions when the Zuider Zee shall be reclaimed.

The possibility of the reclamation of the Zuider Zee first began to be talked about in 1849. In 1870, a royal commission was appointed to report on the embanking of the southern portion of the sea. In 1875 the first sum of money was voted by Parliament to conduct borings in connection with the proposed draining; and in 1877 a bill was introduced for inclosing and draining the southern portion of the Zuider Zee, an area of about 388,000 acres; though this bill was withdrawn by the succeeding cabinet.

April 28th, 1886, saw the institution of the Zuider Zee Association, which has as its object the conducting of technical and financial inquiries about the constitution of an embankment preparatory to a partial draining of the Zuider Zee, the Wadden and Lauwer Zee. It is interesting to note that none other than Dr. Lely was the engineer under whose auspices were conducted all the technical inquiries of the Zuider Zee Association, and that the plan now to be laid before the States General is the identical scheme of the association, amended by the Royal Commission, which was instituted in 1894 to report upon it. Happily for the Netherlands the present year again sees the advent of Dr. Lely as Minister of Waterways, and with him comes the most important plan yet proposed by any government, this being in fact the scheme of the Zuider Zee Association, as elaborated by Dr. Lely himself with the amendments of the Royal Commission. Dr. Lely says it will certainly enhance the importance of the country, and increase the means of subsistance of the people of the Netherlands. The greatest difficulty will be the laying of the embankment* of 29,300 meters in length from Ewyk Sluis, near Wieringen, to Piaam in Friesland. This is to be built in water averaging 3.6 meters in depth below ebb level. The deepest point, the Amstel Diep, between Wieringen and North Holland, is 10 meters below ebb level. The height of the summit of the embankment is to be 5.2 to 5.6 meters above Amsterdam level. This embankment which is to broaden considerably toward the base is to carry on the inner or Zuider Zee side a double-line railroad and a road for ordinary traffic. Its construction is estimated to take 9 years. It is proposed to commence operations by strengthening the ground on the place where the embankment is to stand, in order to prevent scour when the channel is being closed.

Communication with the North Sea will be by thirty-three 5 by 6 sluice-gates, in the very wide canal to be dug through the Island of Wieringen. The combined width of the sluices will be 300 meters, the depth 4.4 meters, Amsterdam level. These sluice-gates will make it possible, in ordinary circumstances, to keep the water level at the present time in the southwestern corner of the Zuider Zee. Besides the thirty-three sluice-gates in Wieringen, there will be two locks, a large one and a small one, for the traffic. Within the embankment, four areas are to be drained, each of which is to be apportioned to the province which it adjoins.

I. The northwest area is 54,270 acres in extent. Of this part, 46,800 acres is clay or sandy clay. II. The southwest area is 78,800 acres, and of this part 69,560 acres is clay or sandy clay. Both these areas adjoin North Holland. III. The southeastern area adjoins Gelderland. It is 269,410 acres in extent, and of this part 229,977 acres is clay or sandy clay. IV. The northeastern area adjoins Friesland, and is 127,125 acres in extent, and of this part 124,260 acres is clay or sandy clay. The total area of land to be gained is 529,605 acres, of which 486,025 acres is clay or sandy clay. The rest is fen and sand. The area of fertile land will be equal to eleven or twelve times the area of the reclaimed land, known as the Haarlemmer Meerpolder. The depth is 4.5 meters below Amsterdam level, this being a little less on an average than the Haarlemmer Meerpolder. Inside the embankment will be left a large lake, the Ysselmeer, the bottom of which will, for the greater part, consist of sand. Its area will be 358,295 acres. This large lake will be needed to serve as a storage reservoir for the water flowing into it from the Yssel and other sources. It must be large enough to serve this purpose, even when high tides prevent the discharge of water from the lake into the North Sea through the 5 by 6 sluices at Wieringen.

In this way a fresh water lake will be formed, from which the surrounding districts can at all times procure fresh water. In times of drought, in summer north Holland now takes in brackish and dirty water from the North Sea canal and in the north also sea water from the Zuider Zee. Salt water often causes diseases in cattle and is a drawback in cheese making. In dry times Friesland has no supply of fresh water. Owing to the want of grass and water the cattle have to be taken to their stalls and the production of milk becomes smaller. Navigation is hampered in consequence of the fall of the water. The small quantity of water in the canals, etc., soon gets brackish, especially in the west of the province owing to the busy traffic through the locks at De Lemmer, Stavoren and Harlingen. This has a not very wholesome effect upon the cattle and upon the dairy produce, and does a great deal of harm to the fisheries in the inner waters and to several industries, boilers having to be cleaned oftener than when fresh water is used. The large fresh water lake will render possible a more effective draining of the land, because, with a large

Typical Dutch architecture in Monnikendam.

Isle of Marken young folk.

The church tower is a landmark for the Zuider Zee fishermen.

* This great embankment is to be built of sand, not of concrete.

Volendam on the shores of the Zuider Zee.

City fathers of the Isle of Marken.

Fishing fleet in the harbor of Volendam.

supply of fresh water always at hand there can be no harm in letting the water run to a very low level in spring. At present this is hardly possible because summer droughts may cause a scarcity of water. The Ysselmeer will raise the value of hundreds of thousands of acres of grasslands in the surrounding districts by rendering the draining more perfect, preventing want of water and improving the dairy produce. The rise in value will probably amount to from $2 to $4 rent per hectare (2.47 acres). The inclosing will further improve the drainage of some districts because the water level of the Ysselmeer will be less variable, and on an average lower than the Zuider Zee level. The navigation will be rendered safer because the water will be smoother and the Zwolssche Diep will be improved. It will lessen the cost of upkeep of water defenses because long lengths of sea-dyke will no longer be wanted and no damage will be done by floods in Overyssel and the north of Gelderland. Besides all these advantages a railroad connection will be provided between north Holland and Friesland. But the greatest advantage of all will be the acquisition of a great area of fertile land.

The existing shortage of land, as shown by the annual returns is due to the fact that the increase of the population, both rural and urban, goes on at a much quicker rate than the acquisition of tillable land. Assuming that, as in the case of the Waard and Groet Polders and the Y Polders, very little of the clay in the Zuider Zee Polder will make permanent pasture, the cultivation of the land will require at least 40,000 peasants, including the laborers. To this number we must add peasants families and some 50,000 tradesmen, handicraftsmen, etc., to get the total number of 250,000 workers, who will find ample means of support in the new Zuider Zee province. In 1907 the rent of clayey land in the Waard and Groet Polders was $40 to $60; of light clayey land, $28 to $36 per hectare. In the Anna Pawlown Polder the rent of the light sandy soil was $20, and that of heavy sandy soil $36 per hectare.

Supposing the average rent of the Zuider Zee areas, where the soil will be much like that of the Waard and Groet Polders, to be only $30 per hectare, we may estimate the total amount of the rentals at $6,000,000 a year. The value of the fish caught in the Zuider Zee is a little over $8,000,000 annually. The value of the crops grown on the drained Zuider Zee areas will be $28,000,000 a year. Canals for use in navigation and for the regulation of the water-level will be dug along the coasts in north Holland, coast of Gelderland and that of Friesland.

The time needed for the work will be thirty-three years, and the embankment, which is to be built of sand, will take nine years. By the end of the fourteenth year, the first land will have been reclaimed, in the northwest area, and in the seventeenth year, portions fit for cultivation and habitation will be offered for sale. The cost will not be prohibitive, some $2,400,000 or $2,800,000 annually, the whole cost of the undertaking being estimated at $75,600,000, exclusive of interest; inclusive of cost of military defences, improvement of the Zwolsche Diep, accumulation of capital to defray the cost of dredging sand and silt from the Yesselmeer, compensation to the fishermen, etc. The reclaimed land is to be government property, and it will be offered for sale, but no certainty can yet be given about which system is to be followed in apportioning it.

Many economists are of the opinion that this would be a good opportunity to make a commencement with a system of small allotments which is now deemed so necessary by them, for the welfare of the agricultural population, and for the prosperity of the entire country.

The Latest Change in the Map of Africa is the amalgamation of Northern and Southern Nigeria into the single colony of Nigeria, dating from about January 1st, 1914. The new colony has an area of 332,960 square miles and an estimated population of 18,000,000.

The sections in lighter tint show the 530,000 acres of land which are to be reclaimed by building an embankment across the mouth of the Zuider Zee.

Inclosing and partial draining of the Zuider Zee.

The Gyroscope in China

An Interesting Y. M. C. A. Lecture That Always Fills the House

By Prof. C. H. Robertson

IN China's series of revolutions since 1900 western science and Christian missions have had great influence. The dynamic combination of these two is well represented in the science lectures that have gone out to the distant parts of the Empire-Republic from the lecture laboratory of the National Committee of the Young Men's Christian Associations of China.

No subject has been more popular than the gyroscope monorail car, as is the meaning of the title shown in Fig. 1. It is pronounced "Pang hsuan chi tan kuei chae." The magic of this name and the elaborate equipment used to demonstrate its principles have drawn tens of thousands of Chinese students, educators, and officials to applaud the fascinating experiments used in the lectures on this unique subject.

In Fig. 2 are shown pieces used to give the underlying principles. The chain on the wheel *A* attached to the rotator shows beautifully the tendency of the links to travel in a straight line due to inertia (the first law of motion). The experiment consists in spinning the wheel up to high speed and then forcing the chain off. When it strikes the floor it does not collapse, but stands up like a hoop made of spring steel and will skip across the stage at high speed until its energy is consumed.

Many interesting and surprising experiments may be made with this one piece of apparatus. For example, if when the chain is forced off, it is caught in a large shallow metal pan, and held at a sufficient slope to prevent the chain running out, it will spin around in a stationary position. If then, the pan be rotated on its center, the chain loop, due to its inertia or persistence of plane, will spin as before and will not be rotated by the turning of the pan.

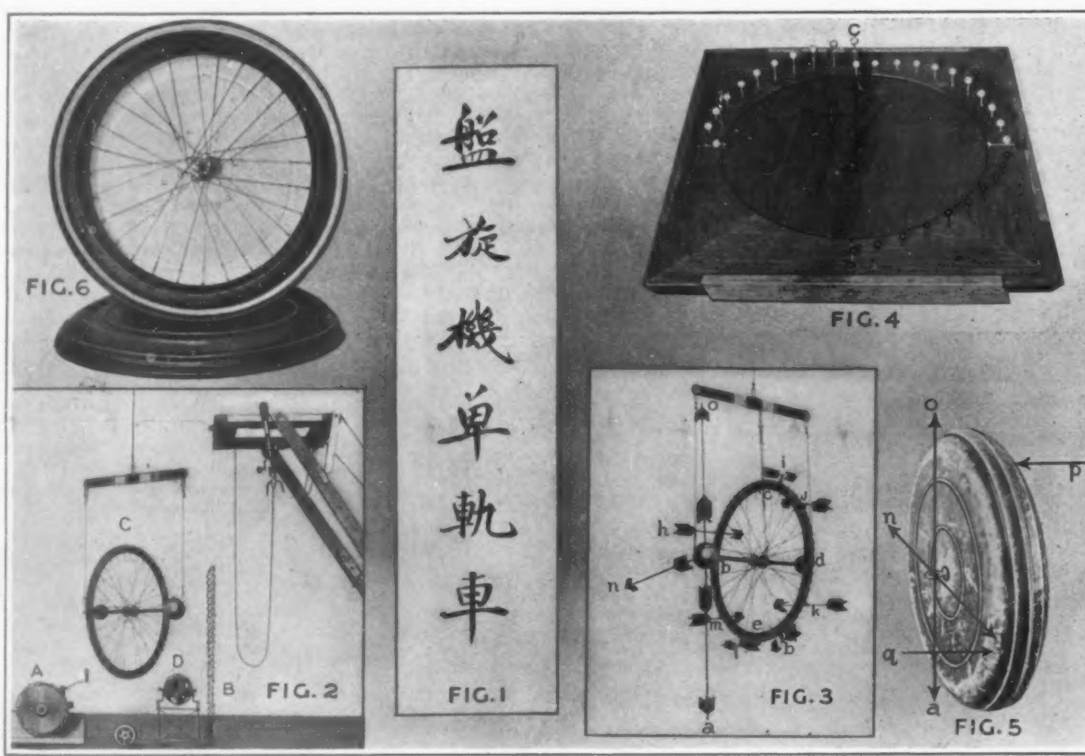


Fig. 1.—The gyroscope monorail car in Chinese. Fig. 2.—Apparatus used in demonstrating the principles of the gyroscope. Fig. 3.—Illustrating the principle of precession in rotation of shaft. Fig. 4.—Showing path of the particles in a quadrant. Fig. 5.—The wrestling gyroscope. Fig. 6.—The construction of the wrestling gyroscope.

Apparatus for a lecture on the gyroscope, used by the Y. M. C. A. of China.

While making some preliminary experiments one day in a long church in the interior of China, the chain was run down from the stage on a board and happened to strike the back of a pew. To the surprise of the writer, it jumped from this to the back of the next one, and the next, and so on, the length of the room. Surprising as it may seem, it will invariably do this if the pews are spaced properly and the chain strikes the first one within a reasonable distance of a certain position and speed. Over a wide range it automatically adjusts itself both as to distance between the seats and as to the distance below its own center at which it strikes. The lower it strikes, the higher and farther will its next jump be. This in turn results in its striking the next one more lightly and not jumping so high, nor so far. After two or three jumps it will come to a state of dynamic equilibrium and skip with great regularity from point to point. This immediately suggested a second experiment—placing a step ladder at an angle of about 30 degrees at the edge of the stage. When the loop strikes the first step, it will jump to the next one, and so on upward until it jumps off the top. This has been an extremely interesting experiment to both Western and Chinese audiences.

If a considerable obstruction, like a folding chair placed upside down, is placed in the path of the loop when running on the floor, it will after striking at high speed, jump several feet in the air, and when it comes down it will not collapse, but will spring up again from contact with the floor, due to what might be called its dynamic elasticity.

The apparatus at *B* (Fig. 2) consists of a larger chain loop suspended by a fine steel piano wire, which may be rotated at high speed through the medium of the flexible shaft, twisted string and rotator. The first effect, due to the tendency of matter to travel in a straight line (centrifugal force), is for the links to move out as far from the center as possible. This still leaves, however, the links at the bottom rotating in small horizontal circles, and it requires but a slight acceleration of speed to cause them to rise in opposition to gravity until the chain is opened out into a complete circle and revolving at high speed in a horizontal plane. It so spins with great steadiness, even though the hand be slid down the wire and much shortening it. If the chain be struck on the side, its circular shape is somewhat altered, but it will so continue with much persistence.

The wheel *C* (Fig. 2) is the result of many attempts to get a satisfactory portable gyroscope of large dimensions capable of being seen clearly by audiences of from one to three thousand people. By reference to the illustration it will be seen that a heavily rimmed wheel is suspended from the ends of a horizontal lever with a fulcrum at the middle. It is used in many interesting experiments. These may begin by clamping the lever across the square frame in place of the chain. If while the wheel stands still one of the end supports be detached, that end of the shaft immediately falls down until it assumes a vertical position. If now the wheel be replaced with the shaft in a horizontal position, and spun up, then when one end is released, instead of falling it immediately begins to precess with the shaft in a horizontal plane. If the speed of precession is accelerated by a little help from outside, the wheel rises up against gravity. If the precession is retarded, it will drop down to a lower plane and will continue these motions for a considerable time. An interesting variation of the same experiment is then made by resting the ball on the end of the shaft in a ball-bearing cup supported by a tripod stand. To hang a large pasteboard box or derby hat over the outer end of the shaft while it is moving around helps a popular audience to realize that there is a remarkable force manifested by such an apparatus.

The audience is always greatly delighted to see some representative from its own ranks trying the strength of the gyroscope by holding the wheel by its shaft, either both hands on one ball or a hand on each ball, and trying to change the plane of rotation at the same time keeping the shaft in a horizontal position. After these preliminary experiments, the mechanism is balanced by sliding the smaller ball (which acts as a counterweight as well) back and forth on the shaft. It will then hang in a horizontal position. If when in this position, and the wheel is standing still, a heavy weight is added to one end of the shaft, that end immediately descends. If now the wheel is spun up and the weight again added, it does not fall, but results in a precession of the shaft about the center of support in a direction depending on the end to which the weight is attached, and the direction of the rotation of the wheel. This leads the way to an explanation of the gyroscope principle.

For this purpose arrows are used, as shown by Fig. 3—b represents the direction of rotation of the wheel and a the force or weight, which applied to the end of the shaft starts its precession in the direction pointed by the arrow. If now the wheel be considered as divided into four quadrants, bc, cd, dc, cb, the effect of adding the weight will be to cause the particles in the quadrant bc to have a tendency to move out from the plane of the paper toward the reader. This path of the particles is illustrated in Fig. 4. The bead f is attached to the wheel, and as it goes through the quarter-revolution from b to c the resultant tendency due to the weight a and the rotation b-c is to take up the curved path represented by the white-headed beads going from b to c. Now if the bead f be returned again to the point b and we concentrate our attention upon the simultaneous motion of g through the quadrant cd, we see that, due to the weight a, it will first have a tendency to move out from the plane of the frame (which was the original plane of rotation), but due to the fact that the wheel is pivoted on the axis bd, it must as a result of the wheel's rotation finally come back again to the original plane of motion at the point d. This at once puts us in a position to realize that the path through which the particle f in the quadrant bc tends to move (due to the action of the weight a and the rotation of the wheel) is quite different from that of the particle g as it simultaneously moves through the quadrant cd. It is of great importance that this be clearly perceived, because the resulting reactions that the particles develop are the forces that make the gyroscope do all of its wonderful and almost incredible antics; and also from which comes its great promise of many practical applications.

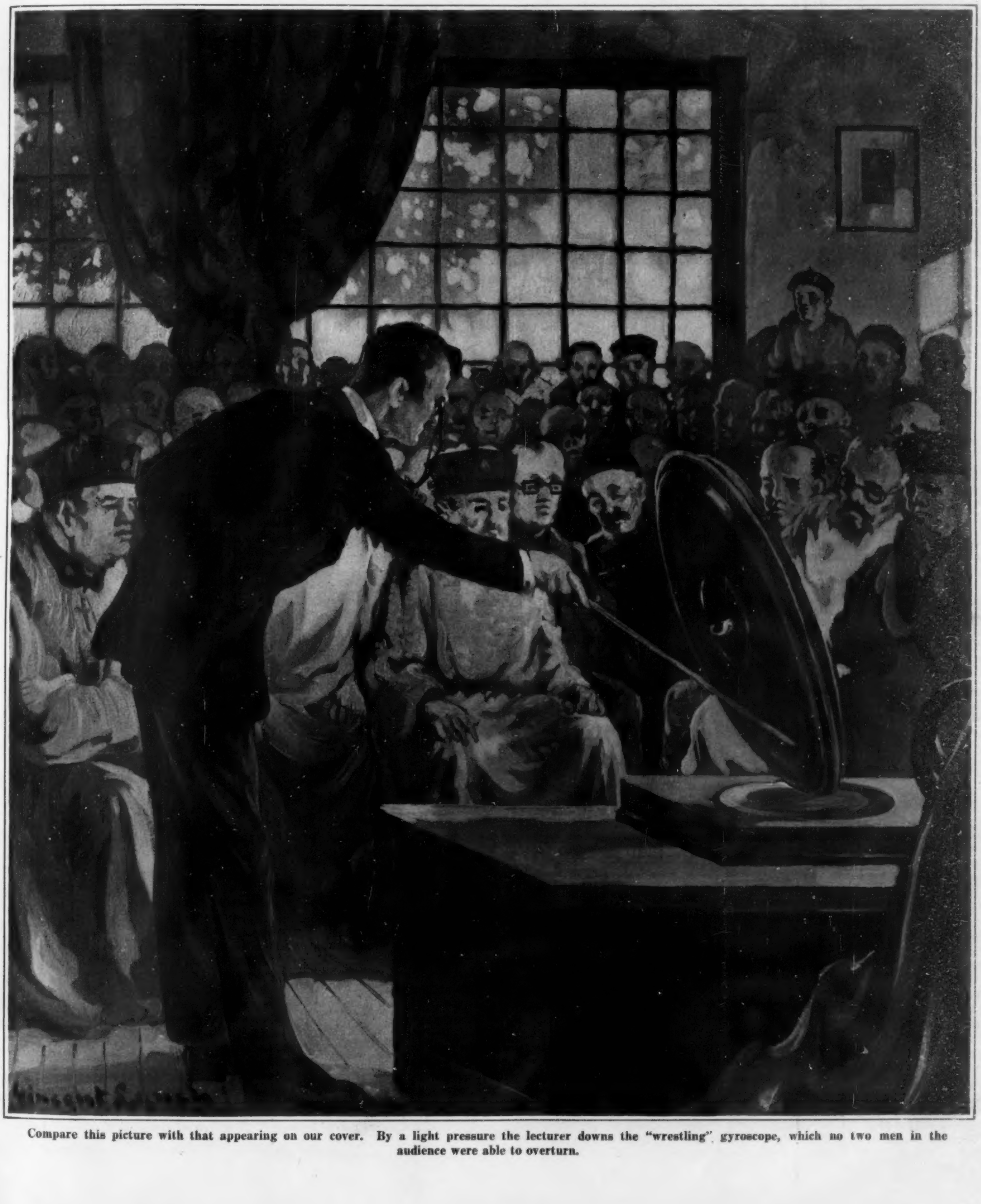
This leads to the question, What are the reactions? The question is very simply answered. Particle b, when it starts moving from the beginning of the quadrant bc, is moving in a definite plane. If at this time the weight a, Fig. 3, is applied, tending to take it out of its plane, it will resist by trying to stay in the plane, due to its momentum or tendency to travel in its original plane. This is true of every particle in the quadrant, and the summation of all the reactions in that quadrant may be represented by the arrow h. A little consideration will show that for the first part of the quadrant cd there is another force (represented by the letter i), which when the particle starts back toward the plane changes to a force in the opposite direction (represented by j).

A more detailed and exact analysis for the quadrant *cd* shows the summation of the forces represented by *j* is a little greater than those represented by *i*, and this is shown graphically by making the arrow *j* longer than the arrow *i*. A moment's thought will suffice to show that the forces in the quadrant *de* (represented by the letter *k*) are equal to and opposite in direction to *h* in the quadrant *bc*; for the quadrant *eb*, *l* and *m* are equal and opposite to *i* and *j* for the quadrant *cd*.

Up to this point we have been considering the motion of the wheel about the axis *bd*. It should be remembered, however, that it is free to move in any direction on any axis, according to forces brought to bear upon it. Let us, therefore, consider the tendency to move about the axis *ee*, Fig. 3. Viewed from this point, we see that in the left half of the wheel *e b c* the summation of the forces is a strong one into the plane of the paper away from the reader, and the summation of the forces on the right half of the wheel *c d e* is a strong one tending to cause the plane of the wheel to move out from the paper toward the reader. If now all these forces *h i j k l m* be replaced by one single force, represented by the arrow *n*, we have arrived at a very important and far-reaching principle—namely, an explanation why, when the force *a* is applied to the shaft of a rotating wheel, the shaft does not move in the direction of the force, but at right angles to it. This conclusion may be stated in the form of a very simple but important rule: "When a force is applied at right angles to the shaft of a gyroscope, the direction of motion of the shaft may be found by rotating the force through 90 degrees in the direction of rotation of the wheel. This second position will be the direction of motion of the shaft resulting from the force." That is, in Fig. 3 force *a* is applied to the shaft when the wheel is rotating in the direction *bc*. If the arrow *a* be turned with the wheel 90 degrees until it comes to *n* it will show the direction the shaft will move. This explains the precession force and direction and puts us in a position at one step to account for the greater mystery of the gyroscope, namely, Why does it not fall under the action of the force *a*? We must remember that the force *a* has developed force *n* at right angles to it and to the shaft; and applying the same rule and the same reasoning up to this point, the force *n* must develop a third force *o*. But one is immediately tempted to ask, Where is this going to end? We begin with force *a* and get a force at right angles to it in the direction *n*; *n* then develops a force at right angles in the direction *o*. The answer is, that the thing ends right there. Because both theory and experiment indicate that, neglecting friction, the force *o* being equal and opposite to the force *a*, they will therefore balance, leaving the force *n* as the one which acts and causes the rotation, which is technically known as precession, at right angles to the first force *a*.

If one wishes further details he may refer back to

(Concluded on page 90.)



Compare this picture with that appearing on our cover. By a light pressure the lecturer downs the "wrestling" gyroscope, which no two men in the audience were able to overturn.

The Unsinkable Ship

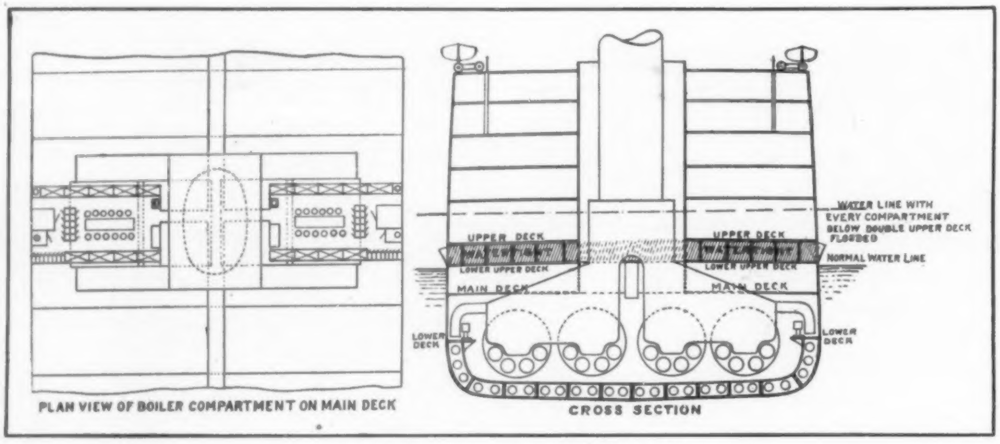
Notable Naval Architect's Design for a Ship That Will Not Sink

TAKING the "Great Eastern" as its text, the SCIENTIFIC AMERICAN at the time of the loss of the "Titanic" stated that it was entirely feasible to so build large passenger ships that they would not founder even under such severe a mishap as befell the "Titanic."

At the last meeting (December 11th and 12th) of the Society of Naval Architects and Marine Engineers, its vice-president, one of America's best known naval architects, gave a paper with plans entitled "On the possibility of building a large passenger liner that would not, under any of the known mishaps at sea, lose her buoyancy or stability and sink."

We present the plans and the following digest of his paper with the conviction that not only would it be unnecessary for such a ship to carry lifeboats; but both in construction and operation it would be an engineering and commercial success.

This paper seeks to point out a possible solution of the problem as applied to a certain type of vessel, viz., the large, modern, passenger liner. New and ever increasing laws concerning life-saving appliances have created a grave problem for the naval architect, both as to carrying heavy top weights and littering a large area of deck space with life boats and rafts. In brief, the suggestions embodied are the fitting of a double upper deck and so arranging the watertight subdivision below the lower member of this deck that the ship would prove both seaworthy and unsinkable under the most aggravated conditions of flooding. The advantages to be considered in this arrangement as opposed to the drawback of wasted space are as follows: The space between the two members of the upper deck would be utilized for cold storage rooms, air ducts, water and steam piping, stores, etc. The fire mains would at all times be under direct control. All horizontal piping and ducts through living spaces would be done away with. Communication to and from engine room, fire rooms, dynamo room, and ventilating and refrigerating rooms would be through a continuous watertight passage fitted with automatic watertight doors which would operate from the influx of the sea.



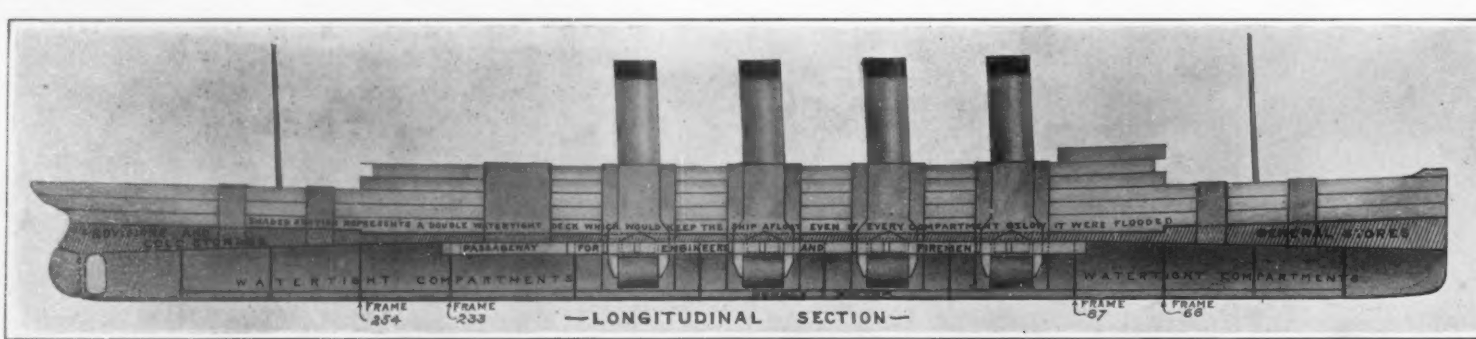
Section and plan views of an unsinkable ship.

With a coefficient of 0.64 these dimensions would give a load displacement of 42,130 tons. There would be a complete double bottom, the inner shell being 4 feet from the outer skin, extending from the fore peak to the after peak and up the sides to the lower deck, which would be 15 feet above the base line. The main deck would be 9 feet above the lower deck and the upper deck 9 feet above the main deck amidships and would extend parallel to the base line from frame 87 to frame 233. From frame 87 to the stem, this deck would slope down, touching the stem at a height of 26 feet above base, and from frame 233 it would slope downward aft, touching the stern frame at a height of 27 feet. There would be twelve bulkheads extending from the inner bottom to the upper deck. These would be absolutely watertight, without any doors or openings whatever.

I think it will be admitted that this ship could be considered safe from any injury to the bottom below the lower deck and that danger of sinking would arise from rupture of the skin above the lower deck and under the water line, which is at the upper deck line. Such danger would arise from collision with another ship at such an angle as would cause penetration, or through striking some stationary mass between the lower and upper decks, opening up several compartments to the sea as in the case of the "Titanic."

Let us first consider penetration by collision. Here the damage would be vertical and might, if the striking vessel were large and nearly at right angles, penetrate quite a distance into the side of the vessel. I think, however, that such a disaster could not entail more than three adjacent compartments if near amidships, or say 219 feet 6 inches. What would be the condition with three adjacent compartments near the center of this vessel flooded? The capacity of one of these compartments would be 163,345 cubic feet, from which would have to be deducted the displacement of the boilers, less furnaces, tubes and combustion chambers, or 13,120 cubic feet. The coal capacity would also have to be deducted, for if half the coal were used the vessel would be 3,000 tons lighters, and if the coal were all on board it would displace so much water, and for this we must deduct 52,000 cubic feet and also 1,740 cubic feet for a central watertight passage under the upper deck. This leaves 98,225 cubic feet or 2,806 tons for each of the three compartments that we consider may be possibly injured through collision, or 8,418 tons to be carried by new displacement. In order to provide the displacement for the condition described above, I would propose to fit what I would term a double upper deck, the upper member of which would be 5 feet 6 inches above the lower amidships and parallel to the base line between frames 66 and 254, at which frames it would rise 2 feet and follow the sheer line to the stem and stern. In case of a collision cutting into the upper member of the upper deck the local damage would be confined practically to the depth of penetration and the width of the striking ship, as the space between these decks would be divided into very small compartments both transeversely and longitudinally. As it is, we have between these upper decks 9,730 tons of displacement which, in case of three compartments being opened to the sea, would leave the upper member still materially above the water line. If the injury was near the forward end of the ship, the lower member of the upper deck extending downward reduces the size of the flooded compartments and the displacement of the contents of the holds, at least 50 per cent would still further have to be deducted, while the upper member rising at frame 266 and following the sheer line would provide sufficient displacement to trim ship till water could be introduced into the double bottom aft. These same conditions would apply in case of serious injury aft. It will be understood, of course, that all openings through the upper deck, such as boiler and engine casings and hold hatches, would be watertight structures for at least 16 feet above the load water line.

We come now to another form of disaster, the ripping open of the side of a ship for a considerable proportion of her length by striking the projecting edge of some obstruction under the water line. In the case under consideration this might happen between the lower and the upper deck for a great portion of the vessel's length. The five large compartments would add 14,030 tons to the displacement, while the forward holds, assuming that the cargo occupied one half the space, would add 3,800 tons more, and the after compartments, if they had to be flooded to trim ship, would add 3,400 tons, a total of 21,000 tons. This would sink the vessel 11.86 feet, or 6.36 feet above the upper member of the upper deck amidships, and she would then draw 43.86 feet. This assumption is to the very limit of the possibilities, yet, for an unsinkable ship, it should be provided against in the design. Between the upper member of the upper deck and the shelter deck there should be no air pores or side lights or if lights are fitted they should not be arranged to open and the glass should be cast around a wire mesh as a protection against cracking.



This ship is rendered safe against either sinking or capsizing by the provision of a double cellular watertight deck at the waterline. If the whole bottom of this ship were ripped open she would settle and ride upon this double deck as upon a second double bottom. Such a ship would be her own lifeboat.

General plan for an unsinkable ship.

In a ship so constructed and practically, at least, unsinkable, would it be necessary to carry the great number of lifeboats now deemed necessary which, with the great freeboards of our ocean liners, are utterly useless except in the event of a moderate sea and the speedy arrival of assistance?

The question of designing a ship that cannot be sunk by any of the known accidents which befall vessels at sea cannot be treated in a general way. The conditions are so varying in different types of vessels that the only way to handle the subject is to assume a certain type and work out the problem in its relation to the assumption, which is what I propose doing in this paper. I have taken a typical large passenger steamer of the following dimensions:

Length between perpendiculars	800 feet
Beam, molded	90 feet
Draught, loaded	33 feet

The objection that would naturally present itself to this type of vessel is the apparent waste of space between the upper decks. This space, however, need not be wasted. Forward of frame 66 this space is 7 feet

(Concluded on page 91)

A Gigantic Electromagnet

By Richard Arapu

THE most powerful electromagnet in the world was recently installed in the laboratory of Prof. Jean Becquerel, in the Paris Museum of Natural History. This electromagnet, which was constructed by Prof. Pierre Weiss of the Zurich Polytechnicum, is capable of producing a magnetic field of 50,000 gausses, at least.

The three most powerful electromagnets which are now in service—in the laboratories of Prof. Weiss in Zurich, Prof. Kayser in Bonn, and Prof. Ames in the United States—produce fields of only 45,000 gausses.

The great power of the new electromagnet of the Museum of Natural History has been obtained by the use of various artifices, and is the result of a series of improvements. The employment of ferro-cobalt in the construction of the pole pieces contributes largely to the result.

In their study of the ferro-cobalts MM. Weiss and Preuss found that iron, having an atomic magnetic capacity of 11, and cobalt, having a capacity of 9, unite to form a ferro-cobalt of definite composition, which possesses an atomic magnetic capacity of 12. In other words, the magnetic strength of this alloy, when magnetized to saturation, is about 10 per cent greater than that of iron, at ordinary temperatures. Using Swedish iron and commercial cobalt, 98.5 per cent pure, as their raw materials, Weiss and Preuss obtained, in different castings, gains of 9 and 9.7 per cent, instead of the 10 per cent gain of the alloy of definite composition. The ingot that gave the smaller increase, 9 per cent, was more compact than the other, and from it the tips of the pole pieces were cut, as the ingot was too small to furnish material for the whole of the pole pieces.

With these ferro-cobalt tips, separated by an interval of one millimeter, the electromagnet, using 22 kilowatts of electric power, developed a field of 55,000 gausses in the intrapolar space. With iron tips a field of 52,000 gausses was obtained in the same conditions, so that a gain of about 5 per cent resulted from the employment of ferro-cobalt. With the ferro-cobalt tips and an intrapolar distance of 2 millimeters, fields varying in intensity from 42,000 to 49,900 gausses were obtained.

In the last-mentioned case the volume of the intrapolar space amounted to about 14 cubic millimeters, sufficient for the introduction of a spark-gap, a little flame, or an absorbent medium. When the intrapolar space was reduced to 0.5 cubic millimeter, which sufficed for the introduction of a particle of radium, a magnetic field of 75,000 gausses was developed.

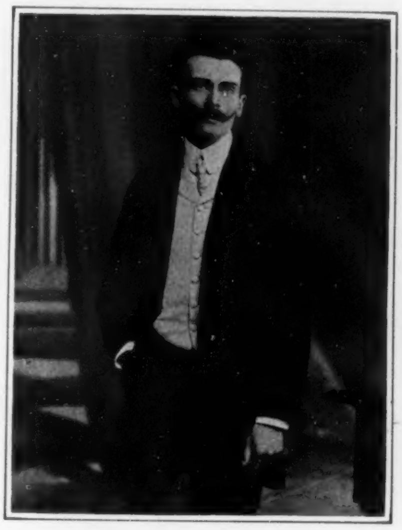
The electromagnet is wound with 1,000 turns of copper tubing, the walls of which conduct the electric current, while the interior serves as a conduit for a cooling stream of water. In order to accommodate the copious flow of water required for refrigeration, the tube is divided into ten sections, which, though electrically connected in series, form ten parallel water conduits. The flow of water is 6 liters per minute and the maximum heating is 50 deg. Cent. The cold water flows first through the innermost tubes, so that the core is always cool. The apparatus attains its normal working temperature in two minutes and maintains it indefinitely. In consequence of this construction it will be possible to operate the new electromagnet continuously for 24 hours. No other electromagnet can be used continuously for more than two hours.

The first experiments that Prof. Becquerel purposes making with this powerful apparatus will have for their object the elucidation of some obscure points in the theory of the Zeemann effect. "It is well known," Prof. Becquerel said to the writer, "that there is something yet unknown in this phenomenon, something that is at the limit of visibility with our present instruments. With the aid of my new electromagnet and its few thousand additional gausses, I hope that I shall be able to make visible this phenomenon, which explains the intimate structure of matter. Molecular and atomic life will reveal, perhaps, part of its secret. When these experiments have been completed I shall continue the study of the effects of magnetic force on matter, in rapid conditions of temperature and pressure."

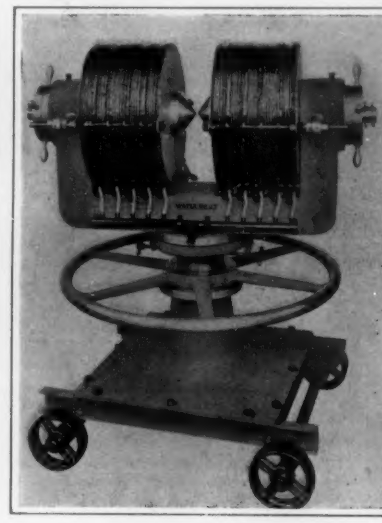
The hope that an electromagnet of vastly greater power, even of a million gausses, may be constructed by international co-operation in a not too remote future, was expressed at the last International Congress of Electricians. According to Ch. Ed. Guillaume, adjunct director of the International Bureau of Weights and Measures, and M. Jean Perrin, professor of physics at the Sorbonne, the total cost of such an electromagnet would equal that of a modern naval "dreadnought," that is to say, 12 or 14 million dollars, and its construction would require the work of several years.

Still more recently, however, at the Chicago meeting of the International Congress of Refrigeration, the distinguished French engineer and physicist, Georges Claude, proposed to employ low temperatures for the production of an intense magnetic field. The electrical resistance of metals at low temperatures is very small. Hence it should be possible to construct a coil, without an iron core, which would produce at low temperatures a very strong and uniform magnetic field of considerable extent, without employing very strong currents or incurring prohibitive expense.

MM. Kammerlingh Onnes and Georges Claude estimate that twenty thousand dollars would cover the cost of an apparatus capable of producing a field of one million gausses at a very low temperature. M. Claude has subscribed two thousand dollars, and Prof. d'Arsonval two hundred dollars of the required amount.



Prof. Jean Becquerel, who purposes making the first experiments with the new electromagnet.



The new electromagnet of the Paris Museum of Natural History, which produces a magnetic field of 50,000 gausses.

Manufacturers of artificial limbs are seeking substitutes for English willow, used because of its lightness and strength. It is claimed that the Port Orford cedar of the Pacific Coast will prove equally serviceable.

An Extemporized Railway Drawbridge

How They Solved a Knotty Problem at Panama

WHEN the Chagres River at Panama is at flood, it brings down from its upper reaches a large amount of detritus, a considerable part of which consists of a kind of gravel which is dear to the heart of the constructing engineer.

Visitors to the Isthmus who are of an inquiring and observant bent of mind, may have noticed not far above the railroad crossing of the Chagres, certain excavators at work upon large beds of gravel. Now that Gatun Lake has risen to its full height of 85 feet, the Chagres at this point and for many a mile above the railway is submerged; and the clear headway between the water and the underside of the bridge is of course considerably reduced.

Recently it was decided to move a dredge up stream and set it to work excavating from the gravel beds of the Chagres River. The dredge was too high to pass beneath the railway bridge, and the problem arose how to get by the obstacle. It was done in the following way:

Two scows were placed beneath one of the plate girders, and upon these was erected a platform, properly braced and trussed, to receive one section of the bridge. Two locomotive cranes were then run up, one on each side of the span, and the latter was lifted off its bearings on the pier. Then the scows with their trucks were floated in beneath the span, and it was towed out of the way until the dredge had passed through. The span was then floated back into position; the two cranes lifted the bridge section from the scows, which were towed out of the way, and the span was then lowered to its footing on the piers.

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Floating out a span of the Gamboa bridge of the Panama Railroad to permit the passage of dredges up the Chagres River.

Ozonized Air

IN the *Journal of the American Medical Association* Drs. E. O. Jordan and A. J. Carlson publish the results of investigations carried on under a grant from the *Journal* and relating to the bactericidal, physiologic and deodorizing action of ozone. Their conclusions are a sweeping arraignment of the now rather widespread use of ozone as a gaseous disinfectant. The writers find that although some bacteria can undoubtedly be killed by ozone, this occurs only when the concentration of the ozone is so great as to be decidedly injurious to man. "If disinfection of a closed room without inmates is desired, this can be much more effectively carried out by the use of formaldehyde or some other familiar gaseous disinfectant than by ozone. Ozone has no place in practical room disinfection." As to the weak concentrations of ozone actually used in ventilation, the writers incline to the opinion that, aside from possessing no sanitary value, such use is probably injurious in the long run, especially to persons with weak lungs. Ozone is not an actual "deodorizer" in concentrations that can be employed in practical ventilation. In very great concentrations it seems capable of oxidizing some odorous substances so that the odors are diminished or changed, but the result may be to make the odor actually more disagreeable. However, the deodorizing effect of highly concentrated ozone is due chiefly to the intense odor of the ozone itself, and possibly to the fatigue or anesthesia it produces in the olfactory epithelium. As a rule such deodorizing is of doubtful utility, and the writers believe that ozone is being used as a means of bolstering up poor ventilating systems.

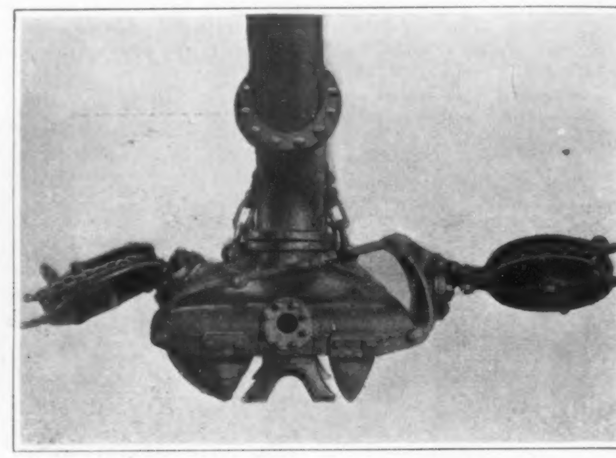
The Philippine Bureau of Forestry uses a launch for service between islands. The United States forest service employs several, both on inland lakes and in salt water, in Alaska and Florida.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Side view of the drag, showing the cutting blades.

Modified type, showing the water jets.



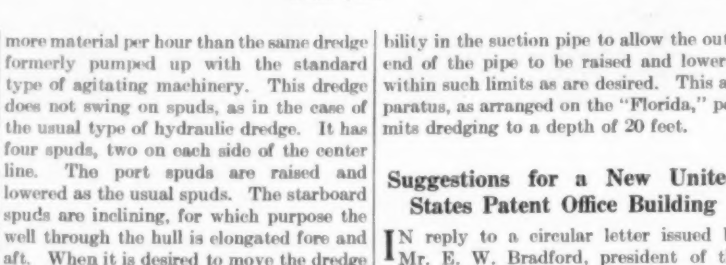
Rear view, showing the scoop at the left lowered and that at the right folded up.

Automatic Drag for a River Dredge

THE ordinary river or pipeline dredge is anchored by a stud or large post which passes through a well in the hull and is driven into the river bottom. The stud then forms a pivot about which the bow of the dredge is swung by means of wire cables anchored at a considerable distance on each side of the bow. The bow of the dredge is swung from side to side in order to bring new sections of the river bed within reach of the suction pipe. The lower end of the suction pipe carries a revolving cage with cutting blades used to scrape and agitate the material that is to be dredged, so that it can be sucked up through the suction pipe. However, the agitating machinery of the suction pipe is somewhat complicated and requires a strong ladder for support and considerable power to drive it, to say nothing of the frequent and vexatious delays for repairs of the complicated mechanism. To overcome these difficulties, Gen. J. W. Sackett has devised a new form of river dredge combining many of the features of the hopper dredge which has a drag at the end of the suction pipe. Instead of moving the whole dredge about on a pivot, he provides for moving the suction pipe with a special form of drag at the lower end.

The form of the drag is shown in the accompanying illustration. It consists substantially of a rectangular bell mouth for the suction pipe; running fore and aft across the bell, is a hollow bar provided with bifurcated blades or teeth. Water is pumped down through a pipe into the hollow bar and issues in jets through openings between the prongs of the teeth. The water jets stir up the material through which the teeth are being dragged. In addition to these teeth, there are four cutting blades secured to the edge of the bell, which aid in confining the loosened material to the bell. In order to trap the material and make sure that it is all carried up the suction pipe, scoops are hinged at each side of the drag. The pulley blocks by which the drag is moved from one side to the other are attached to extensions of the scoops, and these extensions are in turn connected one to the other by means of links, so that when the drag is being pulled to one side, the scoop on that side will be swung on its hinges to the folded position shown at the right hand side in the drawing, while the opposite scoop will be swung to open position, where it will be sure to trap the material scraped up by the cutting blades and teeth. When the drag is pulled to the opposite direction, the scoop on that side will hold and the other one will open.

This type of drag has been in use on the dredge "Florida" on the St. John's River for the past few months and has moved far more material per hour than the same dredge formerly pumped up with the standard type of agitating machinery. This dredge does not swing on spuds, as in the case of the usual type of hydraulic dredge. It has four spuds, two on each side of the center line. The port spuds are raised and lowered as the usual spuds. The starboard spuds are inclining, for which purpose the well through the hull is elongated fore and aft. When it is desired to move the dredge ahead for another cut, the port spuds are raised, the stern paddle wheel is turned ahead, and the starboard spuds, with the points in the bottom, incline forward until an adjustable stop, abaft the spud at the top of the spud well on the lower deck, engages with the after side of the spud; thus regulating the distance moved ahead. The wheel is stopped and the port spuds are dropped; following which the starboard spuds are raised and assume a vertical position, when they are dropped and dredging is resumed. This operation consumes about forty seconds.



Arrangement of the scoop blades and teeth of the drag.

The suction pipe is pivoted on a swiveling elbow. The outboard portion is carried by a horizontal triangular frame, the apex of which is pivoted at the same place as the swiveling elbow. This framework projects over the bow, and the drag is raised and lowered by tackle suspended from a point slightly beyond the frame at the center of its outboard base. At each outboard angle of the frame, posts project downward, which are adjustable as to height and as to various angles with the vertical, and are secured in the position desired. Chains lead from each side of the drag to the foot of each of the posts mentioned and to a convenient place on the frame, where they are made fast. The frame carrying the suction pipe is swung back and forth across the bow of the dredge by means of a wire rope passing along a quadrant on the under side of the frame about midway of its length. By this means a cut 60 feet wide is made. A 10-foot section of hose is provided in the suction pipe of the dredge just beyond the bow of the dredge; which permits sufficient flexibility in the suction pipe to allow the outer end of the pipe to be raised and lowered within such limits as are desired. This apparatus, as arranged on the "Florida," permits dredging to a depth of 20 feet.

Suggestions for a New United States Patent Office Building

IN reply to a circular letter issued by Mr. E. W. Bradford, president of the Patent Law Association, Mr. G. D. Seymour of the Patent Bar made some very interesting suggestions which should certainly be given every consideration when the location, style and arrangement of the proposed new United States Patent Office Building is eventually decided upon.

Mr. Seymour believes that the building should be placed on Capitol Hill as near as may be to the Library of Congress, and that it should be designed in the Renaissance style and built of white or light colored granite. Thus the building would conform with the public architecture of Washington.

It is suggested that the building should be designed with particular reference to the collection and housing of a great working library, constituting a clearing house, so to speak, of information relating to the useful arts. This collection should contain, for instance, all American and foreign patents, technical works in the field of the useful arts, trade catalogues and all like printed material bearing upon patentable structures, processes, and products.

Mr. Seymour believes that the building should also be designed to contain well equipped though not elaborate mechanical and chemical laboratories, where any experiments necessary to be performed in connection with the work of the examiners or tribunals of the office may be carried on.

The Drudgery of Farm Women

PRESIDENT COOK, of the Mississippi Normal College of Hattiesburg, Miss., contends that possibly nine tenths of the drudgery on the farm consists in carrying the water from the source of supply to the point of application and the disposition of the water after use. He points out that a bucket of water contains two gallons and will weigh 20 pounds, and when handled six times the total weight lifted is 120 pounds. He estimates that the use of water in cooking, bathing, scrubbing and weekly washing will raise the lift per day easily to a ton and that this will "take the elasticity out of a women's step, the bloom out of her cheek and the enjoyment out of her soul." He mentions that this daily lift can be eliminated "if the farmer can be brought to see that the farm is also the heir to modern invention," and suggests that an isolated farm can be supplied with a system of water works for an outlay of $250 and that these figures are for first class porcelain lined fixtures. There may be a field here for systematic inventive effort.

The Divining Rod

AT intervals, the divining rod appears in print with its various modifications, and reminds the writer of a story told by a Washington attorney about an applicant for a patent who attempted to demonstrate before the Patent Office Examiner the efficiency of his divining device in discovering gold. He said he was prepared to demonstrate the device, and the Patent Office official placed a small box in the middle of the room for him to sit on and told him he had concealed some gold coin, which he proceeded to "find," but with no success. Then the examiner told him there was a quantity of gold ore in the room, and the inventor, after several futile attempts, failed, and attributed the failure to his exhausted condition from traveling. The device, according to the inventor, indicated the gold ore as located at various points along the walls of the room and the examiner told him finally it was in the box on which he was sitting. The inventor appeared sincere in his efforts, but had evidently been carried away by his enthusiasm and did not again attempt to assert his claims.

Legal Notes

Some Patent Adjudications.—In Reece Folding Machine Company vs. Earl vs. Wilson, the Fenwick patent No. 606,528, for a machine for holding and pressing blanks for collars and cuffs has been held infringed on a motion for a preliminary injunction: the Dormandy patents No. 904,317 and 924,151, for machines for folding and compressing blanks for collars and cuffs has been held infringed on a motion for preliminary injunction and the Reece patent No. 972,916 for a machine folding and pressing blanks for collars and cuffs has been held infringed on a motion for preliminary injunction.

RECENTLY PATENTED INVENTIONS

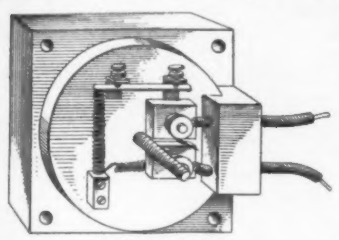
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

DRESS SHIELD.—H. P. RINDSKOPF, 397 Summer Ave., Brooklyn, N. Y. This shield reinforces the seam or union of the sides of a shield and minimizes the cost of construction incident to the reinforcement. Its two sections are crescent-shaped, having a curved edge to fit under the armpit. The sides are preferably united at the arm seam by adhering the edges of the two sides at the point.

Electrical Devices.

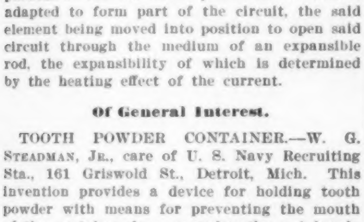
CIRCUIT BREAKER.—A. GUERRA, Celaya, Guanajuato, Mexico. This invention is directed more particularly to a thermo-electric apparatus, though generally relating to electric circuit breakers. It provides a thermally-controlled circuit breaker adapted to open a circuit under certain conditions of load. The apparatus is characterized by a movable element adapted to form part of the circuit, the said element being moved into position to open said circuit through the medium of an expansible rod, the expansibility of which is determined by the heating effect of the current.



CIRCUIT BREAKER.

Of General Interest.

TOOTH POWDER CONTAINER.—W. G. STEADMAN, JR., care of U. S. Navy Recruiting Sta., 161 Griswold St., Detroit, Mich. This invention provides a device for holding tooth powder with means for preventing the mouth of the container from engaging the wet brush, thereby obviating the danger of the power becoming caked around the exit opening in a manner common with the ordinary container. The container distributes the powder evenly on the brush, and means provide for securing economy in the use of the tooth powder.



TOOTH POWDER CONTAINER.

Of Interest to Farmers.

BROODER.—J. A. CLARK, Bolckow, Mo. This invention comprises a combined brooder and coop construction which is so mounted as to be automatically actuated by the weight of the chicks it contains, to cause the same to close up and house and protect the chicks when a certain number of the young fowls have entered the same.

Of General Interest.

SURGICAL APPLIANCE.—M. IVERSEN, Stoughton, Wis. More particularly the invention is directed to an improved dropper, which is especially adapted for use in douching. The object of the inventor is the provision of a reversible dropper through which the fluid is adapted to be passed either in large quantities, as in giving enemas, or in certain determined quantities, as in protoclysis. In the use of this appliance there will be no effect of back-pressure on the dropper as the pressure will be the same on both sides; and there will be a free return for the gases and liquids in case of the patient pressing.

FILM PACK.—J. E. PETTIBONE, 4240 Flad Ave., St. Louis, Mo. In this pack the films are attached to a continuous strip so arranged that at no time during the manipulation of the films is there more than a single tab exposed, wherein the moving of each film from exposed position uncovers the succeeding film, the strip to which the films are attached being so folded that each fold when pulled straight will move the film attached from the point to the rear.

FURNACE FOR TREATING ORES.—J. A. FREY, Silver Spring, Md. By means of this device ores such as those containing sulphur, arsenic, and the like may be treated in order to bring them into a state from which the valuable metals may be readily extracted. Steam is passed into the furnace under high temperature and pressure in order to aid in the treatment of the ores.

BINDING EYELETS.—W. R. INGHRAM, care of Mrs. Eva L. Inghram, 56 E. Wayne St., Waynesburg, Pa. This invention is for use in securing together in book form a series of periodicals, and has for its object the provision of means whereby the members of the series may be connected together in interlocking relation and in such manner that they may be opened in the same way as a book.

ADVERTISING MEDIUM.—G. T. FIELDING, 575 Fordham Road, Bronx, N. Y., N. Y. The intention here is to provide a medium more especially designed for use in show windows and the like, and arranged to effectively advertise a desired line of merchandise by attracting the attention of passersby for a considerable length of time.

VAULT DOOR.—G. W. KENNINGTON, 416 3rd Ave., Brooklyn, N. Y. In this patent the object is to provide a vault door, which is simple and cheap in construction, and which may be readily operated, the door being constructed in a manner that will leave it normally flush with the door frame.

GOGGLES.—L. D. CUTLER, P. O. Main St., Windsor Locks, Conn. In this invention a close fitting of the lenses to the face and especially at the nose is insured to prevent dust or other foreign matter from passing into the eyes of the wearer, and means provide for properly supporting the goggles at the nose without undue strain.

EVAPORATING APPARATUS.—D. COZZOLINO, P. O. Box 465, Escondido, Cal. This invention relates to apparatus for dealcoholizing, condensing, evaporating or distilling liquids, such as beer, ale, stout, malt extracts and the like, and semi-liquids, such as crushed fruit, jams, crushed vegetables and the like.

COMBINATION PIPE AND CIGAR HOLDER.—M. H. BARON, 147 W. Broadway, N. Y., N. Y. This invention provides a smoker's implement comprising a tobacco-holding member, a shield for the same, a mouthpiece associated with the member, and a deflector intermediate the member and the mouthpiece for deflecting the smoke on its way from the member and the mouthpiece.

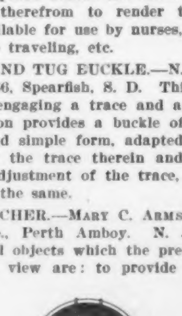
COMBINED CIGAR BOX AND HUMIDOR.—L. BRENAUER, 68 E. 104th St., Manhattan, N. Y., N. Y. This invention is more particularly intended for embodiment in cigar boxes, although capable of use for other vendible goods or materials requiring to be kept in a moist condition. It provides an original package in which cigars and other goods may be vended, and having a self-contained humidor, including a removable element having an absorbent material.

CORK RETAINER.—O. B. SCHELLBERG, 1058 Southern Boulevard, Bronx, N. Y., N. Y. This invention is characterized by the absence of sharp angles where the different portions adjoin, the structure being further characterized by a gradual curvature between portions extending angularly with respect to one another, whereby in the handling which the device must receive in use the tendency to damage is materially lessened.

COMBINED WORK BAG AND RETICULE.—HELEN H. TERRY, Southampton, N. Y. The invention refers more particularly to a device which comprises an outer bag or envelop having means whereby it can be closed, and an inner, foldable member having means for carrying different toilet or other articles, and adapted to be disposed within the outer envelop, or withdrawn therefrom to render the articles thereon available for use by nurses, maids and others while traveling, etc.

TRACE AND TUG BUCKLE.—N. L. ANDERSON, Box 386, Spearfish, S. D. This buckle is for use in engaging a trace and a hame tug. The invention provides a buckle of light construction and simple form, adapted to adjustably receive the trace therein and permit of the ready adjustment of the trace, to shorten or lengthen the same.

FLY CATCHER.—MARY C. ARMSTRONG, 225 Kearny Ave., Perth Amboy, N. J. Among the principal objects which the present invention has in view are: to provide means for holding adhesive paper or material in a manner to protect the same from accidental contacting with adjacent articles; and to provide a frame for supporting adhesive material or paper for disposing the same in convenient position and for otherwise handling the trap.



FLY CATCHER.

Hardware and Tools.

WATCHMAKER'S TWEEZERS.—H. E. HOLLOWAY, 149 Prospect St., Trenton, N. J. In carrying out this invention use is made of a pair of tweezers which have their clamping ends bifurcated, one side of which is so curved that when the bifurcated ends of the tweezers engage the overcoil end of the hairspring in the watch, they cause the end of the spring to bend in the desired direction while the main portion of the hairspring remains flat on the watch.

Machines and Mechanical Devices.

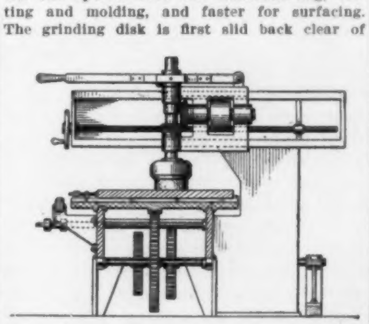
FRICTION CLUTCH.—L. A. PAGANI, 1031 Willon Ave., West Hoboken, N. J. This invention pertains to machine construction and has particular reference to clutches adapted for connecting one running part, for simultaneous operation, to another part. The object of the invention is to provide a friction clutch provided with novel means by adjusting the gripping shoes.

ARITHMETICAL ABACUS.—J. M. DE LA ROSA, Arequipa, Peru. This invention relates to an arithmetical abacus or device for use in instructing any one, including deaf mutes, in the study of numerals, and it has for an object to provide an improved arrangement of mechanical members on which numerals, fractions, and other information are placed, the entire arrangement being such as to present various information in any desired order.

CLUTCH MECHANISM.—E. C. WILLS, 116 E. Church St., Frederick, Md. This invention refers to clutch mechanisms adapted for general use and more particularly to clutch mechanism used in connection with shafting for the purpose of connecting shaft sections together, and then disconnecting them under such conditions that when connected they will have no slipping movement relatively to each other.

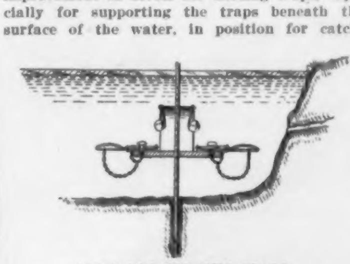
SAFETY ATTACHMENT FOR ELEVATORS.—H. J. PIEPGRAS, Caldwell, Idaho. This invention comprises a safety attachment for stopping the elevator in case the load is not removed therefrom before the elevator platform reaches the highest point of its travel, and thus avoiding injury to persons or things on the platform and damage to the elevator parts.

MARBLE SURFACING MACHINE.—C. H. JORDAN, 1015 Birch St., Richmond Hill, N. Y., N. Y. This machine grinds the surface of marble or slate slabs down to a true surface and even thickness, and also countersinks to an even depth by means of a heavy iron disk with blocks of carborundum attached. It is also provided with an attachment that can be used for side cutting and molding. The table has two speeds—slow for countersinking, cutting and molding, and faster for surfacing. The grinding disk is first slid back clear of the table. Thus unobstructed, the full size slab of marble or slate is placed on the table, the heavy iron grinding disk with the carborundum blocks is brought forward over the marble slab, the sleeve on the spindle is set and secured so as to grind down to the required depth, the disk rotating is moved back and forth at will and the table on which the slab is placed is moved back and forth in the opposite direction, thus grinding down the entire surface of the slab.



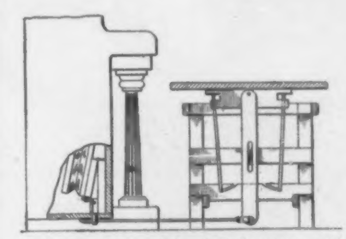
MARBLE SURFACING MACHINE.

STOOL FOR HOLDING TRAPS.—W. GREEN, Box 70, Holly, Mich. This invention is an improvement in stools for holding traps, especially for supporting the traps beneath the surface of the water, in position for catching muskrats and the like, and having mechanism for supporting bait in proximity to ordinary steel traps, and so arranged that the animal cannot obtain access to the bait, except by passing over the trap. When the animal scents the bait he tries to obtain the same, and will pass over the adjacent trap to reach the bait. As he steps upon the bait pan, the trap will be sprung.



STOOL FOR HOLDING TRAPS.

BELLOWS ACTUATING MECHANISM FOR MUSICAL INSTRUMENTS.—J. P. RAWLS, 1715 Gervais St., Columbia, S. C. This invention relates to means for operating musical instruments, such as organs, player pianos and the like which include power bellows and is in the nature of a player's bench and certain novel connections with the instrument whereby the instrument bellows may be actuated by a minimum effort on the part of the player. It provides a highly efficient construction adapted to support the player of the instrument and to be actuated by a simple body movement of the player without necessitating pedaling of the feet, as is usual.

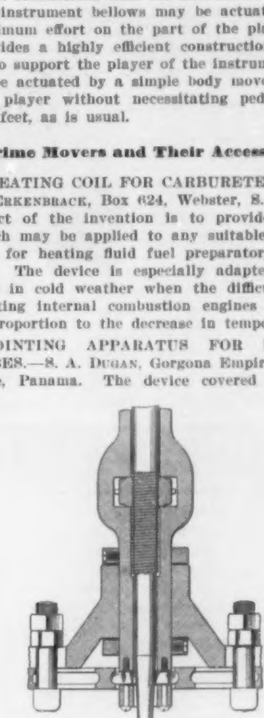


BELLOWS ACTUATING MECHANISM FOR MUSICAL INSTRUMENTS.

Prime Movers and Their Accessories.

HEATING COIL FOR CARBURETERS.—W. A. ERKENBRACK, Box 624, Webster, S. D. An object of the invention is to provide a coil which may be applied to any suitable carbureter for heating fluid fuel preparatory to its use. The device is especially adapted to be used in cold weather when the difficulties of starting internal combustion engines increase in proportion to the decrease in temperature.

JOINTING APPARATUS FOR BOILER TUBES.—S. A. DUGAN, Gorgona Empire, Canal Zone, Panama. The device covered by this patent is for jointing the tubes of steam boilers to the tube sheets. The inventor produces an annular depression in the sheet to receive the tube, and he employs for the purpose a hollow shaft having radially movable cutters, which are gradually expanded by a tapered spindle, the spindle shank being threaded and receiving a nut fitting in a recess in the shaft.



JOINTING APPARATUS FOR BOILER TUBES.

Pertaining to Vehicles.

AUTOMATIC PUMP.—G. J. SPOHRER, care of Wilson Motor Starter Co., Franklin, Pa. This invention more particularly pertains to a pump adapted to work with an internal combustion engine and more particularly adapted to supply compressed fluid to an automobile for the purpose of supplying energy to actuate an engine starter or to supply a source of power for any other purpose.

Designs.

DESIGN FOR A TOOTH BRUSH.—C. E. CARROLL, Newport, Ark. In this ornamental design for a tooth brush Fig. 1 shows a side view, Fig. 2 an end view of the same.

DESIGN FOR A CLOTHES LINE FASTENER.—J. MURPHY, 178 Hoyt Ave., Brooklyn, N. Y. In this case Fig. 1 is a front view in perspective of a clothes line fastener, showing the new design; Fig. 2 is a rear view; and Fig. 3 is a cross section of Fig. 2 indicating the surface configuration.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

An Electrical Automobile Transmission System

(Concluded from page 78.)

and constant torque on the propeller shaft is practically obtained.

Obviously, the functions carried out in driving the car can in a measure be reversed when the car is coasting with the engine running free. In this case the electric transmission then operates as an efficient brake in which there is nothing to wear. It will hold the speed of the car down to approximately 10 miles an hour on any grade where traction is obtainable.

The operation of starting the motor scarcely can require explanation. Current is drawn from the storage battery and passed to the field of the generator. Normally this would cause the armature to rotate and the car would be propelled backward. But when the brake is set, locking the propeller shaft, the field then rotates about the armature, and thus starts the engine. The electric motor serves a secondary purpose. When the car is driven on what corresponds to high gear, it furnishes current to maintain the battery in a charged condition, the current supplied being at the rate of about 10 amperes. When the car is standing, connections can be established with the control lever which will give a charging rate of up to 30 amperes, this rate being useful after the car has remained idle for a long time or for emergency.

The system is not untried, for it has been in use in a car that has been driven for upward of 16,000 miles over roads good, bad and indifferent, practically all over the United States; incidentally, that its efficiency really is as stated is demonstrated by the fact that the gasoline consumption of the car was no higher than that of the ordinary car.

The Gyroscope in China

(Concluded from page 85.)

Fig. 4. Considering the motion about the axis *ce*, the motion of the particles in the quadrants are now shown by the position of the black beads, and we quickly arrive at the same conclusion; that the force *n* will develop a similar force *o*. A natural question at this point is: But since the shaft appears to move around in a horizontal circle, its rim does not move out as indicated in the different quadrants. How then can it develop the forces indicated? It is a good question. The answer is that the wheel rim does move out just as assumed. The proof may be had by making an enlarged photograph of the path of the free end of the shaft, and it will be found that it is made of a series of spiral loops. If *a* represents the force of gravity, *o* will be equal to it in an opposite direction, thus preventing its falling; and the experimental proof of this is the fact that such a wheel does not fall, but moves off at right angles to the direction of this force, in the direction *n*.

This gyroscope *c*, Fig. 2, also serves to illustrate one aspect of the gyroscope as a compass. If after it is spun up, the shaft is placed in a north and south position so that the large ball is pointing toward the north, and it be lifted up by means of the cord attached to the fulcrum at the center of the lever, it may be carried all about the room and swung round several times in each direction, and taken back to the stage, when it will be observed not to have departed from the north and south direction during its journey. This of course does not go into a deep explanation of how the centrifugal force due to the earth's rotation is made to act on a delicate gyroscope to cause it to take up a position so that its axis will be parallel to that of the earth, nor does it explain how the corrections are made due to the forces developed by the motion of the ship carrying it. But it does go a long way toward giving a popular audience an impression of its possibilities in that direction, as in the compass so skillfully worked by Mr. E. S. Sperry in America and others in other parts of the world. (See Fig. 2.)

Of very great interest also is the gyroscope shown at *D* in Fig. 2. This gyroscope has extended shafts on the horizontal side rings. It is first used without the stilts shown underneath it in the picture. The legs that are extended into sockets at the top of the stilts are sharp. When spun up it balances perfectly on these sharp legs. A weight is added to the cup shown at the side of the frame; instead of sinking down, the side where the weight is applied actually rises. This is due to the fact that in order to stand it must keep its center of gravity over the point of support. The only way to do this is by elevating the side upon which the weight is applied. In Mr. Brennan's monorail car, a large party may stand on one side, then rush in a mass to the other, resulting, not in depressing, but in raising the side to which they go.

This explains also why in rounding a curve the car tips up on the outer side in proportion to the speed and radius of the curve, so that to occupants it is as though the car were traveling in a straight line with the floor level. This is illustrated in this model by replacing the sharp legs by grooved wheels which are capable of running on a wire stretched in the air or laid on the floor as a track. This improvised monorail car will balance itself on such a wire even through a considerable weight is applied to one side or the other. The wire may be swung back and forth, but still it retains its balance without difficulty. After the experiments have been made in this way, the stilts as shown in Fig. 2 are then added, and even though they are high in proportion to the size of the gyroscope it is able to stand up and even run on the wire when the grooved wheels are placed at the bottom of the stilts.

The rule above stated is capable of giving a very quick and practical solution of many gyroscope problems; for example, let us apply it to the case of the "wrestling" gyroscope, Fig. 5. This and several other pieces of apparatus used in this article were constructed by Mr. M. M. Wood of Berwin, Ill.

The wrestling gyroscope has been one of the very popular features of the gyroscope lectures in China. Its construction is readily understood by reference to Fig. 6. It consists of a strong bicycle wheel with the rim loaded with lead pipe and then wound with spring brass wire. When spun up to high speed and the case closed and set upon its edge, as shown in Fig. 5, it will stand up with a slight list to one side, and will precess slowly around on a nearly vertical axis. A member of the audience is invited to use a strong staff padded at one end with a solid rubber ball and make the wheel lie down on its side. (See cover illustration.) Any attack upon it above the middle develops a powerful and instantaneous reaction; and unbelievable as it may seem, it is nevertheless a fact that the strongest man is unable to push it over. This experiment delights the audience, and after two men have joined hands and been unable to push the gyroscope over, the audience is willing to accept the statement that a fairly light wheel running at a comparatively slow speed is able to develop a very heavy reaction. The audience then also readily comprehends how it may be possible for a wheel weighing tons and running thousands of revolutions per minute, to furnish a basis for stabilizing a monorail car or opposing the rocking of a ship.

Now how does the precession rule apply in such a case as the wrestling gyroscope shown in Fig. 5? It is seen that the case leans slightly toward and to the left of the reader. The force that is acting upon it is its own weight, which may be represented by a downward force from the ring represented by the arrow *a*. Now if the bottom of the wheel is traveling from the reader, the application of the rule (rotate the force *a* 90 degrees with the wheel) would result in the arrow *a* being rotated to point in the direction *n*. This would cause precession, due to the force *n*, and would result (by a second application of the rule) in the development of a force *o* which would counteract the gravity tendency at *a* and prevent the wheel's falling. Now suppose that a heavy external force is applied, as represented by the arrow *p*. The effect of this would be roughly speak-

INQUIRY COLUMN

Inquiry No. 9346. Wanted the name and address of parties manufacturing tobacco stripping machines, and other machines pertaining to cigar manufacturing and cigar banding machines.

Inquiry No. 9347. Wanted the name and address of an industrial school where shoemaking is taught in all its branches.

Inquiry No. 9348. Wanted the name and address of manufacturers having useful household necessities, with a view to obtaining exclusive territory for a house to house canvass.

Inquiry No. 9349. Wanted the names and addresses of the makers of machinery for making Malt Tonic, also a machine for making grease, and machines for applying plaster (Cement Gun).

Inquiry No. 9350. Wanted the name and address of the manufacturer of a printing press for the printing of tapes for clothing. The machine should preferably be worked by hand.

Inquiry No. 9351. Wanted to make some article out of wood which could be made from 2 inch ash, by party having 75,000 or more feet of waste per year which is now used for fuel.

Inquiry No. 9352. Wanted the name and address of a person who is in a position to get the state or county agency for articles of merit that can be sold to business houses or others at $3.00 or over. No kitchen utensils desired.

Inquiry No. 9353. Wanted the name and address of a manufacturer who can make flexible oil cans.

Inquiry No. 9354. Wanted the name and address of a manufacturer of a machine which will stitch silk around small metal rings.

Inquiry No. 9355. Wanted the name and address of the maker of triplex glass.

Inquiry No. 9356. Wanted the name and address of a manufacturer who can build an *automobile wheel*, also a *cigar vending machine*. Concerns in the middle West preferred.

Inquiry No. 9357. Wanted the name and address of a manufacturer of a machine for scalloped paper favors and cups.

Inquiry No. 9358.—Wanted the name and address of maker of a machine to cut all granulate leather.

ing to immensely increase the force *a*. This would result in an increased precessional force *n* which would increase the force *o*, which is just in the direction to oppose the force *p*. The reasons are shown in Figs. 3 and 4 with the accompanying explanation. The experimental proof is the fact that two men are unable to apply enough force at the point *p* to upset the wrestling gyroscope, which has a total weight of about thirty pounds.

It is always of great interest to the audience to see the experiment made in which, by applying the little finger to the wrestling gyroscope, it is controlled and made to lie down. A very slight pressure applied as shown by the arrow *q*, with the little finger, is sufficient to overcome the precessional force *n* due to the weight of the wheel, and it will slowly settle down to the floor in a direction opposite to that shown by the arrow *q*; for if *q* be replaced by the equivalent force *r* and the rule applied, it will show that *r* will result in a force downward coinciding with *a* and helping the gyroscope to come to the floor. This also is the explanation of how, by the use of a small lever, a large car like that constructed by Brennan is tipped down to the ground for convenience in loading on freight.

The Unsinkable Ship

(*Concluded from page 86.*)

6 inches high, increasing to 12 feet at the stem, and could be utilized to receive stores of all kinds, the compartments being only open at certain hours for issuing the day's supplies. The space from frame 254 aft, starting at 7 feet 6 inches and increasing to about 12 feet in height, could be divided into cold storage compartments for all the different kinds of provisions. The space amidships, 5 feet 6 inches high, would form the sub-basement for the hotel part of the ship above. All ventilating ducts, salt and fresh water mains and drainage pipes would be arranged in this space so that only vertical piping would be carried to the rooms. This grouping of all piping and ducts which run horizontally would save much trouble both in the design and working qualities of these systems. This I consider a very important feature in such a design. One of the hardest problems the designer has to face is dealing with pipes and ducts through living quarters, and it is always the horizontal pipes that give trouble. By having the main of these systems between the upper decks where they are accessible at all times without the passenger knowing anything about them, a continued source of dreaded trouble is removed and, furthermore, this would not interfere with the proper subdivision of the space.

Referring to the cross section through one of the boiler compartments, it will be observed that I have provided a longitudinal passage under the upper deck. This passage would be extended through each compartment, from which it would be entered through an air lock, and it would extend from frame 87 to frame 233. In each boiler compartment on each side would be the living quarters for all the men engaged in that compartment. These quarters would be artificially lighted and ventilated. The air would be taken from ducts between the upper decks on the inboard side, discharge at the floor line and would pass up through ventilating pipes on the outboard side. It might be objected that these quarters would be hot in spite of good ventilation. In this connection I consider it quite unnecessary to have much heat in the boiler rooms. The boilers in such a ship would be worked under forced combustion and in that case the fans for forced draught could draw the air from the outer casing round the smokestack and uptakes and discharge it into a casing outside the boiler lagging so arranged that the air would circulate round the boilers on its way to the tubular heaters in the uptakes. Thus any heat radiating through the lagging on the boilers would be taken up by the air for combustion, leaving the fire rooms comfortably cool, and with cold air freely circulated through the living quarters they should be quite comfortable.

The air lock doors into the central passage would be self-closing, balanced doors, easy enough for a man to open but certain to close after him, and it would hardly be possible to conceive of any damage to this passage even from a collision with a very large ship. At both ends of this passageway would be stairs in a water-tight well leading to the shelter deck.

Astronomical Bulls

IT is worth the trouble of studying astronomy just to be able to realize the delicious humor of the blunders committed by non-astronomical people, and especially the journalistic tribe, when they have occasion to discuss the heavenly bodies.

A fresh crop of astronomical bulls is given to the world in a recent number of *l'Astronomie*. After the partial eclipse of the moon of April 1st last, a French newspaper commented thus on the event:

"The phenomenon could be especially well observed because the moon was just at the full last night. What rare good luck for an eclipse!"

In 1911 Brooks's comet attracted more or less attention on the part of the newspapers. *La Presse* of September 28th, 1911, announced that the celestial wanderer "is now to be found in the constellation of Cygnus, three degrees north of Alpha, the upper star of the *Southern Cross*." Of course the cross in question was not the famous asterism of southern latitudes, but that formed by the principal stars of the Swan, lying along the Milky Way.

Of the same comet an Italian newspaper, *La Tribuna* (Rome), gravely stated that at five o'clock in the morning "its tail measures 20 meters long by about 3 meters broad at the end." We fear Mr. Kipling would not have agreed with these dimensions. One could not make much impression on a "ten-league canvas" with so small a brush. Nothing is more common than this habit, on the part of the laity, of estimating the apparent size of celestial objects in terms of a terrestrial scale. It would be extremely interesting to compare such estimates, e. g., of the diameter of the moon—from a number of the persons who appear to apply this method of measurement with such facility.

A Parisian newspaper recently undertook to compute the cost of a voyage to the moon, on the basis of current railway tariffs on our planet. The result was somewhat impaired by the fact that the writer confused the distance of the moon with that of the sun.

Why do artists persist in painting the new moon with its horns turned the wrong way? At last we have found a clew to this enigma. It is not merely a little joke on the part of the painters, comparable to the plumbers' time-honored prank of putting the hot-water handle on the cold-water faucet and *vice versa*. The moon represented in these productions is, it appears, not the astronomical moon at all, but the *lune de miel*—a body notoriously exempt from all natural laws. One sees at once the beautiful appropriateness of the fact that the walls of the marriage office at the *mairie* of the fifteenth arrondissement in Paris have just been embellished with a picture of this sort.

An Opinion of the Scientific American

THE *A B C Pathfinder Railway Guide* publishes the following:

"The SCIENTIFIC AMERICAN, which is to the mechanically inclined all that the mariner's compass is to the sailor, has just completed its sixty-ninth year and the *Pathfinder*, but four milestones behind, congratulates its colleague upon its achievements of the past, its standing of the present, and trusts the future will bring it the prosperity it merits.

"Transatlantic travelers do themselves an injustice if they are not equipped with the marvelous compilation known as the SCIENTIFIC AMERICAN Hand-Book of Travel which is a most accurate and complete guide for the amateur or experienced traveler and an invaluable hand-book for the stay-at-home."

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

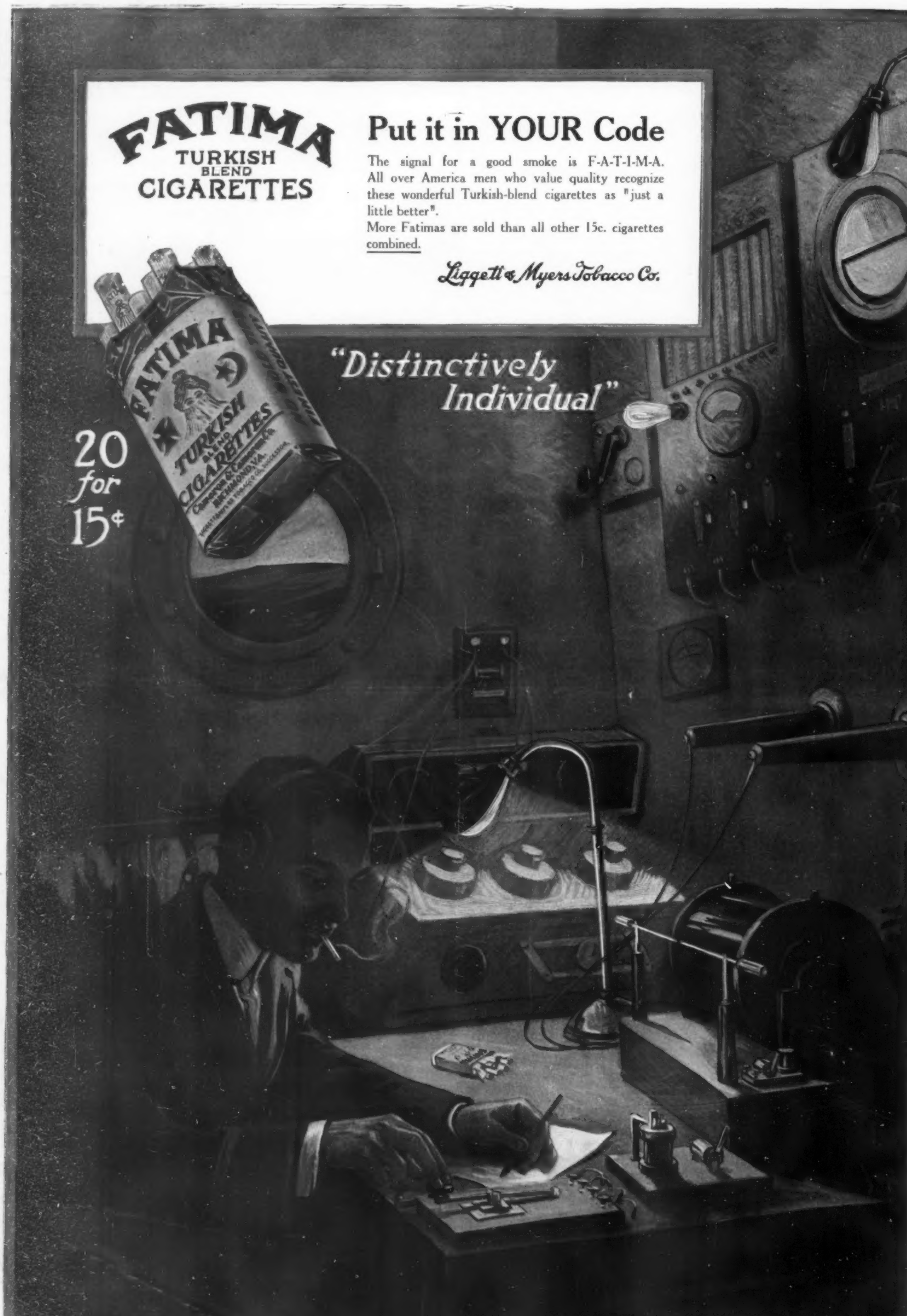
(12922) W. S. asks: Here on Gulf coast the sun rises on 31st June fully 25 degrees north of an east and west section line. Does the sun travel directly east and west on the tropic of Capricorn on the 31st of June? If so, the survey line is not right, for the tropic is south of us. A. The latitude of your place is not far from 30 deg. 15 min. north, and the tropic of Cancer, not Capricorn, where the sun is on June 21st, is in latitude 23 deg. 30 min. north. The sun, which is in the zenith of the tropic of Cancer at noon on June 21st, will be about 6 deg. 45 min. south of your zenith at noon on the same day. The sun rises in the east and sets in the west on March 21st and September 21st to all the world, and only on those days. From March 21st to September 21st it rises to the north of east and sets north of west, and from September 21st to March 21st it rises south of east and sets south of west over all the earth. At your place the sun never travels on an east and west circle through the day. It always moves obliquely up in the forenoon and down in the afternoon.

(12923) F. S. P. asks: Have you a SUPPLEMENT containing the formula for making electropoion fluid used in charging carbon batteries, consisting of sulphuric acid, potash, etc.? A. There are a great variety of electropoion fluids, in which the same ingredients are used but in different proportions. A reliable mixture may be made of 40 parts water, 5 parts potassium bichromate, and 10 parts sulphuric acid, all by weight. Dissolve the potassium bichromate in the water, heating it if necessary to produce solution, and add the sulphuric acid, pouring it into the solution slowly, and with constant stirring. The same weight of chromic acid may be used in place of the potassium bichromate. We send you SUPPLEMENT 792, which contains full instructions for making a very serviceable battery to use with this fluid.

(12924) E. E. D. asks: How much horsepower, approximately, can be expected from a 40-inch Leffel vertical water-power wheel with an abundance of water at 11½ feet head? Is that the kind of wheel to use with such a low head? Could a Francis tube wheel, such as shown in your September 13th number, be used to advantage? What is the advantage of draft tubes used below the turbine? How do you figure horse-power by the use of friction band (on line shaft pulley) attached to lever which in turn rests on a pair of scales? A. With a 12-inch intake you should develop from 18 to 20 horsepower with a 11½-foot head. With the use of draft tubes a Leffel turbine should be about as efficient as any other, although the writer would much prefer one of the Francis or Fourneyon type. The draft tubes below the turbines, by setting up a suction, convert the head in the outlet channels, which would be otherwise lost, into effective head which is added to the head above the turbine in the computations. The velocity of the pulley rim is measured by a counting apparatus. By the bolt B, v can be made constant at any desired value. By reading the weight G on the scales, the friction (F) becomes known as $Fa=Gb$. Then the work for any unit of time is $L=Fv$.

(12925) J. M. B. asks: Will you kindly state if there is a book published that will give a correct and up-to-date method of honing a razor? A. We do not know any book upon honing razors. Our "Scientific American Cyclopedia," price $5, contains several modes of preparing razor paper, strops, etc., which we can recommend as good. The only mode of honing a razor of which we ever heard is to lay the razor flat upon the hone and draw it along the hone, turning it over its back for the return stroke. It is usual to draw from heel to point as it is moved to and fro. 2. Is aluminium good? If so, what grade or kind of aluminium is best to use? A. We never heard of aluminium for honing razors. It is much softer than steel, and so could not cut down the steel of a razor to a cutting edge. Hones are either oil or more often water stones of a very fine grit.

(12926) M. G. K. asks: If a bowl of water is placed upon a scale and the net weight is exactly 10 pounds (bowl about half full) and a live fish of about 1 pound is added to the bowl of water, is the weight of the bowl of water increased? I have heard that it is not with a live fish, but that it is with a dead one. A. The bowl, water and fish in your question weigh all together 11 pounds and the scales will indicate that weight, whether the fish be alive or dead, or whether a fish, a stone or even water, be added to the amount of 1 pound. Probably the reason this question arises so often in the case of a live fish is that the fish does not touch the dish, and seems to be borne up by the water. But the level of the water in the dish is raised and the effect is the same as if a pound of water were poured into the dish. If that was done, no one would think that the weight on the scales would not be increased; why should they when the fish is added to the matter upon the scales? One pound of fish weighs the same as one pound of water, and affects scales to the same amount.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TURKISH BLEND CIGARETTES